

F/Lt. J. B. Veal flying inverted over Hamble in one of the Avro 621 Tutors of Air Service Training Ltd. during the A.S.T. 'At Home' on August 3, 1934. The well-known factory building, birthplace of so many famous Avro aircraft, is discernible vertically below the airscrew hub.
(Charles E. Brown Photo.)

AVRO AIRCRAFT SINCE 1908

A. J. Jackson

PUTNAM
LONDON

BY THE SAME AUTHOR

British Civil Aircraft, 1919–1959
(Two volumes)
De Havilland Aircraft Since 1915

© A. J. Jackson 1965
Printed and bound in Great Britain for
Putnam and Company Ltd
42 Great Russell Street, London WC1
by William Clowes and Sons Ltd, Beccles
Set in Monotype Plantin
First published 1965

R533.678
RJ132A
AERONAUTICS FUND
NOV 22 1965
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CONTENTS

Foreword 7
Roe I biplane 9
Roe I triplane 12
Roe II triplane 17
Roe III triplane 20
Roe IV triplane 24
Avro Type D 26
Avro Curtiss-type 33
The Duigan biplane 35
Avro 500 (Type E) 38
The Burga monoplane 45
Avro Type F 46
Avro Type G 49
Avro 501 and Avro 503 (Type H) 52
Avro 504 to Avro 504H 56
Avro 508 66
Avro 510 68
Avro 511 71
Avro 519 73
Avro 521 75
Avro 523 Pike 77
Avro 504J and Avro 504K 80
Avro 527 and Avro 528 90
Avro 529 92
Avro 530 95
Avro 531 Spider 98
Avro 533 Manchester 102
Avro 504K (civil) 105
Avro 504K (overseas) 116
Avro 504L 134
Avro 504M 138
Avro 534 Baby 140
Avro 536 149
Avro 539 154
Avro 547 158
Avro 548 162
Avro 549 Aldershot 169
Avro 552 174
Avro 504N 179
Avro 504K Mk. II 193
Avro 504Q 195
Avro 504R Gosport 197
Avro 555 Bison 202

Avro 557 Ava 207
Avro 558 210
Avro 560 214
Avro 561 Andover 217
Avro 562 Avis 220
Avro 566 Avenger 224
Avro 571 Buffalo 227
Avro 574, 575, 586 and 587
(Cierva C.6C, C.6D, C.8V and C.8R) . . 231
Avro 581 Avian prototype 235
Avro 584 Avocet 240
Avro 594 Avian 243
Avro 604 Antelope 254
Avro 611 and Avro 617 (Cierva C.8L) . . . 257
Avro 612 (Cierva C.17) 261
Avro 616 Avian IVM 263
Avro 618 Ten and Variants 273
Avro 621 Tutor 283
Avro 626 and Variants 292
Avro 627 Mailplane 299
Avro 631 and Avro 643 Cadet 302
Avro 636 308
Avro 638 Club Cadet and Variants . . . 311
Avro 641 Commodore 316
Avro 652A Anson Mks. I to X 319
Avro 679 Manchester 334
Avro 683 Lancaster 339
Avro 683 Lancaster (civil and experimental) . . 350
Avro 685 York 357
Avro 652A Anson Mks. 11 to 22 364
Avro 688 Tudor 1 373
Avro 689 Tudor 2 380
Avro 691 Lancastrian 385
Avro 694 Lincoln 393
Avro 696 Shackleton 403
Avro 698 Vulcan 408
Avro 701 Athena 414
Avro 706 Ashton 418
Avro 707 422
Avro 748 426
Appendix A Construction for Other Manufacturers 433
B Aircraft designed by A. V. Roe Canada Ltd. 441
C Unbuilt Avro Projects . . . 447
D Individual Histories of British Civil Avro 504Ks 459
Index 467

FOREWORD

The career of Alliott Verdon Roe, founder and first designer of the great British aircraft manufacturing firm of A. V. Roe and Co. Ltd., who flew model gliders from the s.s. *Inchanga* in 1901–02, won prizes for rubber driven models in 1907, made the first sustained flight in an all-British aeroplane in 1909 and was knighted for services to aviation in 1929, is too well known to need repetition. This book seeks instead to record as completely as possible all aeroplanes which have borne the Avro trademark, together with something of their technical details and operational histories.

From 'stick and string' days at Brooklands, Shoreham and Manchester, the story covers the First World War era and the production of that now-legendary masterpiece, the Avro 504 in all its variants. Their descriptions spread through the book in chronological sequence. Hamble, birthplace of classic Avro seaplanes, where Bert Hinkler tested military and civil prototypes designed by Roy Chadwick between the wars, was the scene of early autogiro experiments which qualify for chapter status because complete Avro airframes were used.

In 1928 'A. V.' left the firm and the story moves again to Manchester where in 1936 the company became a member of the Hawker Siddeley Group. It tells of world sales of Avian and Tutor derivatives and production of those giants of the Second World War, the Anson and Lancaster. From the York and a series of interim passenger transports it proceeds to the mighty Vulcan delta bomber and comes finally to the turbine powered Avro 748, last aircraft to originate with the Avro prefix. Later designs had H.S. designations resulting from a change of company style to the Avro-Whitworth Division of Hawker Siddeley Aviation effective from July 1, 1963. Information given in the chapter on the Vulcan is confined to that already made publicly available.

Painstaking research has brought to light unpublished material which disproves a number of long-accepted theories, but definite records do not go back beyond 1912, a period when A. V. Roe was preoccupied with the basic problem of getting off the ground and found little time for making notes. The frequency with which his primitive machines were reconstructed, coupled with the vague and indefinite information given by a (then) inexpert Press and the fallibility of human memory, has led to the identity of several of these early aeroplanes being misrepresented or going entirely unrecorded. Descriptions are often contradictory and many statements for which there is no justification have attained a false air of authenticity through constant repetition, the Roe III triplane in particular having come down the years in

a welter of conflicting statements. Thus it may never be possible to write a full history of 1908–11 Avro aeroplanes and relevant chapters of this book are therefore presented in as much confirmed detail as possible, without any claim to completeness, in the earnest hope that they form the most satisfactory record published so far.

Completed aircraft account for only some 30% of Avro designs. A list of all unbuilt projects so far released for publication is given therefore in an appendix, together with details of four types built for other firms, and four built by A. V. Roe Canada Ltd. Having no Avro origins, Hawker Audax, Bristol Blenheim and English Electric Canberra aircraft built by the firm are not discussed.

New material made available from Avro records has led to the inclusion of several details which are intentionally at variance with the author's "British Civil Aircraft 1919–1959", and made possible complete listings of production aircraft. Initial markings alone are quoted except where subsequent identities are demanded by the story and in the unique Avro 504K joyriding saga. Similar treatment for the civil Anson is beyond the scope of the present volume.

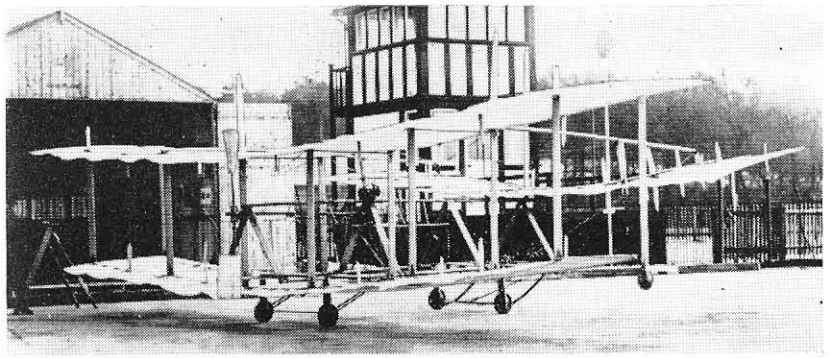
The author acknowledges with gratitude enthusiastic help given by several specialists whose contributions have enriched this work, notably D. E. Monk; H. Holmes; C. H. Barnes; J. M. Bruce M.A.; J. A. Bagley B.Sc.; H. F. Cowley; W. Duigan of Geelong, Australia (1911 biplane photographs); F. G. Miles; K. M. Molson, Curator of the Canadian National Aviation Museum (early Canadian data and photographs); P. W. Moss; Bruce Robertson; D. E. Roberts B.Sc.; H. E. Scrope; E. Taylor; L. E. Bradford who prepared the three view drawings; and the author's wife who typed the manuscript so expertly.

Valuable assistance was also received from the Avro-Whitworth Division of Hawker Siddeley Aviation; Rolls-Royce Ltd.; H. F. King M.B.E., Editor of *Flight International* and Miss A. Tilbury (*Flight* photographic department); D. Dorrell, Editor of *Air Pictorial*; J. W. R. Taylor, Editor of *Jane's All the World's Aircraft*; J. H. Blake, Editor of the *Royal Aero Club Gazette*; the Editor of *Lloyd's List and Shipping Gazette*; F. H. Smith, Librarian of the Royal Aeronautical Society; the Airworthiness Department of the Ministry of Aviation; the photographic section of the Imperial War Museum; and J. A. Pryor and D. P. Woodhall of the Air Historical Societies of Australia and New Zealand respectively.

The following gentlemen have also contributed materially to the completeness of this book: R. C. B. Ashworth; C. A. Nepean Bishop A.R.Ae.S.; T. W. Boughton, J. Hopton and C. A. Lynch (Australia); P. T. Capon; J. R. Ellis (Canada); C. A. van der Eyk (Netherlands); J. S. Havers; W. K. Kilsby; H. Kofoed (Denmark); G. S. Leslie; C. Longworth-Dames; O. G. Nordbø (Norway); and E. Rerren (Belgium).

A. J. J.

Leigh-on-Sea, January 1965



The Roe I biplane at Brooklands in 1908 showing the 9 h.p. twin cylinder J.A.P. engine amidships. *(Photo courtesy of the Royal Aeronautical Society.)*

Roe I Biplane

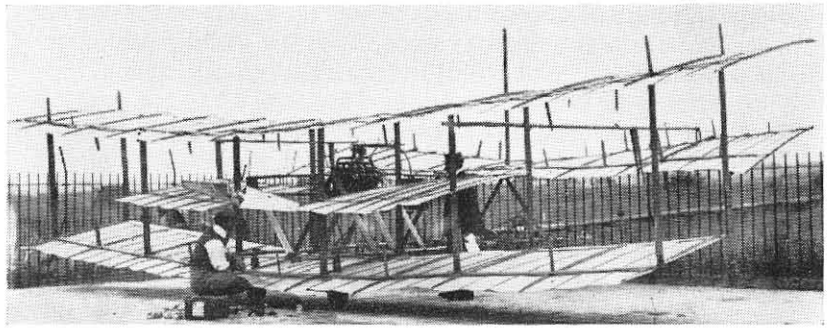
A. V. Roe's first man-carrying aircraft was a canard biplane of wire braced, wooden construction, similar to the Wright-type model with which he won £75 at Alexandra Palace in April 1907. The aircraft was built round a large white wood, three bay, triangular structure mounted on four home-made pneumatic tyred wheels, the front pair being steerable. The pilot sat in the forward part of the machine and a 9 h.p. J.A.P. aircooled motorcycle engine was situated amidships, driving a two bladed paddle-like pusher airscrew through five feet of extension shafting which formed the apex of the central structure. Wing construction was primitive, the main spars being external and therefore thin to reduce drag. For rigidity it was necessary to employ a large number of bracing wires and kingposts with the result that the cotton covering could only be applied to the underside of each wing. The covering was then tightened with a coat of size and the whole wing structure braced from three much taller kingposts. There were no ailerons and no rudder but a car-type steering column warped and pivoted the large front elevator and so gave both lateral and fore-and-aft control. A. V. Roe was the true inventor of the single-lever type of control and had patented such a system as early as 1906, ante-dating the claims of Continental inventors by several years.

The Roe I biplane was built in the stables behind the surgery of A. V. Roe's brother Dr. S. Verdon Roe at 47 West Hill, Putney, London, and on completion in September 1907 was taken to Brooklands, where Roe hoped to make an attempt to win the £2,500 prize offered by the owners for the first flight round the track before the end of that year. Although a great deal of taxying was done along the concrete track, the 9 h.p. engine was not powerful enough and the biplane flew only when towed by friendly racing motorists. Such flights were successful on straight tows, but turns resulted in sideslips and damage until Roe designed a quick-release which enabled him to cast off

at will and make controlled landings. In this way he learned the feel of the controls but the end of the year came without the prize being awarded.

'A.V.' then negotiated the loan of a 24 h.p. Antoinette eight cylinder, watercooled engine designed and built in France by Levasseur. It had copper water jackets and direct petrol injection and on its arrival in May 1908, gave Roe the extra power he so badly needed. To carry the increased weight, extra wing area was provided by inserting short stub wings at mid gap in the inner wing bays. Unfortunately the extra power was more than his airscrews could absorb and many blade failures occurred, but the trouble was eventually cured and in the early morning of June 8, 1908, he succeeded in taking the biplane off under its own power and in making several hops at a height of 2 to 3 ft. above the track. A. V. Roe did not publicise his achievement and two years passed before he let it be known that he had left the ground in 1908. In 1928–29 the Gorrell Committee of the Royal Aero Club disallowed his claim to have been the first to fly in Britain on the grounds that he had not been airborne for a sufficient distance, ruling that the first Briton to do so had been J. T. C. Moore-Brabazon in a Voisin biplane at Eastchurch nearly a year later.

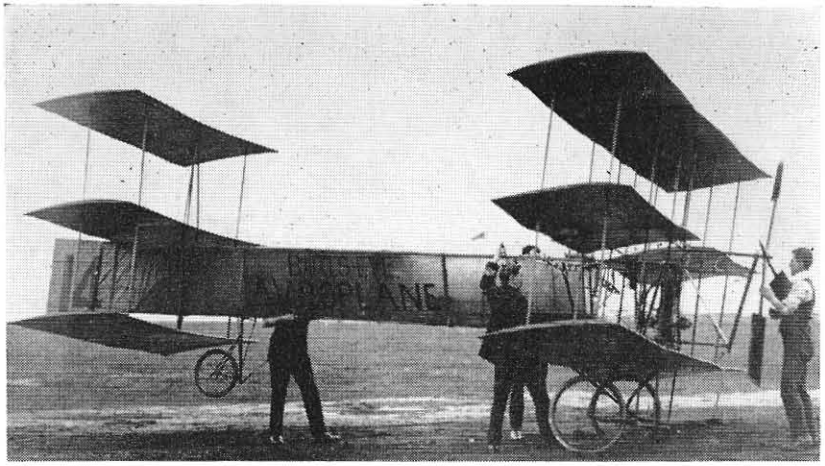
During his long stay at Brooklands Roe received no encouragement from his landlords. The Clerk of the Course, E. de Rodakowsky, put every possible obstacle in his way and was openly hostile to aeroplanes, so that when the 1908 motor racing season opened, Roe's shed was pressed into use as a refreshment room and the biplane banished to a field behind the track. Track attendants stumbled under the load while lifting it over the fence and dropped the machine into a dried-up dyke where it was damaged beyond repair. Roe was heartbroken but received no compensation and was forced to send the engine back to France as he could not afford to buy it. He dismantled the remains of the aircraft, keeping only a wheel and a few other selected parts to remind him of some of the ingenious constructional methods he had used. In later years these items were preserved in a glass case at his home as a part of the Roe private aeronautical collection.



A. V. Roe working on the Roe I biplane after it had been fitted with a 24 h.p. eight cylinder Antoinette engine.

SPECIFICATION AND DATA

Construction:	By A. V. Roe at 47 West Hill, Putney, London, S.W.15
Power Plants:	One 9 h.p. J.A.P. One 24 h.p. Antoinette
Dimensions:	Span 30 ft. 0 in. Length 23 ft. 0 in.
Weights:	Tare weight 350 lb. All-up weight 650 lb. Weight of Antoinette engine (without radiator) 98 lb.



A. V. Roe at Blackpool with the first Roe I triplane in October 1909. (*'Flight' Photo 0140.*)

Roe I Triplane

In partnership with J.A.P. engine designer J. A. Prestwich, A. V. Roe next made an abortive attempt to complete a triplane with square section fuselage and triplane tail. A 35 h.p. engine would have been needed and this they could not afford. The partnership consequently dissolved and the fuselage, wings and undercarriage went under the hammer at Friswell's for £5 10s.

Lack of funds thus compelled Roe to design his next aeroplane round the same heavy 9 h.p. J.A.P. engine which had first powered the Roe I biplane and to build it of wood instead of light gauge steel tubing as intended. The design was a generally similar, but much more elegant, version of the Voisin brothers' clumsy Goupy II tractor triplane, with a fuselage of three deal longerons with cross struts which formed a strong, wire braced, triangular section girder. The main undercarriage consisted of two cycle wheels in reversed forks with a smaller cycle wheel under the tail.

Fore and aft movement of a lever gave control in the pitching plane by changing the mainplane incidence, and lateral control by a side to side movement which warped the centre mainplane. This in turn warped the other two mainplanes through push rods. The incidence of the large triplane tail unit was intended originally to vary in unison with that of the mainplanes but the tail was eventually fixed rigidly to the fuselage. There were no movable surfaces but large vertical fins were fitted between the interplane struts of the tail unit. A 9 ft. diameter, four bladed airscrew mounted on a shaft some 3 ft. above the engine, was driven sometimes by motorcycle belt and sometimes by chain, using different sized pulleys or sprockets to give a variety of gear ratios.

The outer 6 feet of wing panel folded back for ease of transport and housing, other refinements including the suspension of the pilot's seat and petrol tank wholly within the fuselage on rubber webbing made in H. V. Roe's Bulls Eye Braces factory. This feature gave rise to the legend "Bulls Eye Avroplane" painted on the sides of the fuselage, an inscription which contracted rapidly into the Avro trademark so well known today.

The components of the Roe I triplane were made at Putney in May 1909 and erected with the assistance of E. V. B. Fisher and R. L. Howard Flanders at Lea Marshes, Essex, where A. V. Roe had rented two railway arches and converted them into workshops. On the first two hops the triplane heeled over and smashed the port wing tips because the pilot lacked experience and failed to warp and lift the wing quickly enough. As soon as the cause of the trouble was realised, Roe began (in his own words) "making dozens of short flights up to 50 ft. in length at a height of 2–3 ft. which were hardly more than jumps". The first of these jumps was made on June 5, 1909. Once airborne there was insufficient power for sustained flight and further experimenting took place with different gear ratios and airscrews of varying diameter and blade width, adjustable for pitch on the ground. Results of these trials were carefully recorded and in the course of further hops Roe discovered the need for a small rudder and learned how to improve acceleration by avoiding excessive use of the fore-and-aft control on take-off. He flew 100 ft. on July 13, 1909 and on Friday July 23, at the second attempt, made a much improved take-off and flew 900 ft. at an average height of 10 ft. Two more flights of this length were achieved on the same day and A. V. Roe thus had the distinction of making the first flight over British soil in an all-British design powered by a British engine.

Although nominally of 9 h.p., his well worn power plant was so oversize internally that it was then giving 10 h.p., a simple development which has led, many times, to the erroneous conclusion that Roe built a later triplane with a 10 h.p. J.A.P. engine. This old power unit weighed 150 lb. with accessories, so that Roe's flights were a remarkable achievement indeed, for at an all-up weight of 500 lb. the power loading was at least 50 lb. per h.p.

Flights continued throughout August and the fuselage was covered with yellow oiled paper. Later the vertical tail surfaces were removed. Greatly encouraged by his success, Roe then built a near identical second triplane fitted with his new 20 h.p. J.A.P. four cylinder, aircooled engine. This aircraft closely resembled a design which gained him a mark of 74% and second prize in a competition organised by the magazine *Aeronautics* in July 1909, and both triplanes were entered for the all-British prize at the Blackpool Race Meeting of October 18–24, 1909. Here the original machine carried competition number 14 on the rudder and was promptly christened "Yellow Peril" by the spectators on account of its all-yellow covering, but unfortunately the oiled paper was seriously affected by incessant rain and sagged to such an extent that Roe's only flying comprised a few short hops of up to 150 ft., made on October 19. Although he hurriedly erected the untried second machine



The second Roe I triplane (identified by cylindrical fuel tank, tail skid and tapered fuselage, in flight at Wembley, December 1909. (*Photo courtesy of P. T. Capon.*)

and had it ready to fly on October 21, storms prevented further flying and the all-British prize was not awarded.

Blackpool Week 1909 ended the active career of the first Roe I triplane. It made a brief reappearance at an aero exhibition held at Belle Vue Gardens, Manchester, January 1–3, 1914, spent 11 years in storage at the Manchester factory, and was presented in 1925 to the Science Museum at South Kensington, London where it remains on permanent exhibition.

The airframe of the second Roe I triplane closely resembled that of the first but fortunately there were several prominent recognition features which made it easily distinguishable from its forebear. Whereas the earlier aircraft had a fuselage of constant depth and large tail wheel, the second fuselage was tapered towards the rear and equipped with a long tail skid. There were also additional struts in the undercarriage. The first machine had a small fuel tank mounted on a fuselage longeron but the second had a narrow, cigar-shaped tank on struts ahead of the pilot to give a greater head of fuel. It must also be remembered that only the first triplane bore the fuselage inscription "Bulls Eye Avroplane" under which appeared a clearly painted figure 3, indicating that the inventor regarded it as his third individual aeroplane. He had meanwhile been evicted from Lea Marshes and on his return from Blackpool, transferred to Old Deer Park, Richmond, Surrey. The new site proved unsuitable and late in November 1909 he moved to Wembley Park, Middlesex, where on December 6 the second Roe I triplane made its first exploratory flights with encouragingly few mishaps. The 20 h.p. J.A.P. (the actual output of which was more like 14 h.p.), improved the performance to the point where local authorities sportingly felled a number of trees to enable him to

fly a circular course and land back at his starting point. Attempts to improve the control system were not always successful as on Christmas Eve 1909 when Roe found it impossible to lift the port wings quickly enough and sideslipped into the ground, once more demolishing the port mainplanes.

In January 1910, with financial help from his brother H. V. Roe, the private firm of A. V. Roe and Company was formed with workshop space in the factory of Everard and Company at Brownsfield Mills, Manchester. This was the company, wholly owned by H. V. Roe, which manufactured elastic webbing and the famous braces. Wembley Park flying ground was retained until Maj. Lindsay Lloyd converted the centre of Brooklands track into an aerodrome. 'A.V.' then returned to the scene of his 1908 experiments and made three half-mile introductory flights there on March 11, 1910. He then left for London to look after his new Roe II triplane, the first example of which, named "Mercury", was that day introduced to the public at the Olympia Aero Show.

No doubt influenced by the success of contemporary biplanes, he later tried out this configuration using the second Roe I triplane as a guinea pig. All three outer wing panels were removed and the top two replaced by others similar to, but longer than, those of the Roe II "Mercury". At the same time a "Mercury"-type bottom centre section and improved undercarriage were fitted. The tail wheel from the original Roe I triplane was borrowed and fitted into a strengthened mounting, a piece of cannibalism which explains its absence from the Science Museum exhibit to this day. When flown in this guise at Brooklands on Easter Monday 1910, the aircraft was nicknamed the "Two-and-a-Bit Plane" but the advent of newer designs speedily ended its career and the old aircraft was dismantled at Brooklands at the end of the following month.



"Two-and-a-Bit Plane"—the second triplane with extended biplane wings, tail wheel and "Mercury" undercarriage at Brooklands 1910. (*'Flight' Photo.*)

SPECIFICATION AND DATA

Construction: By A. V. Roe at 47 West Hill, Putney, London, S.W.15; erected at Lea Marshes, Essex (1st machine) and Blackpool, Lancs. (2nd machine)

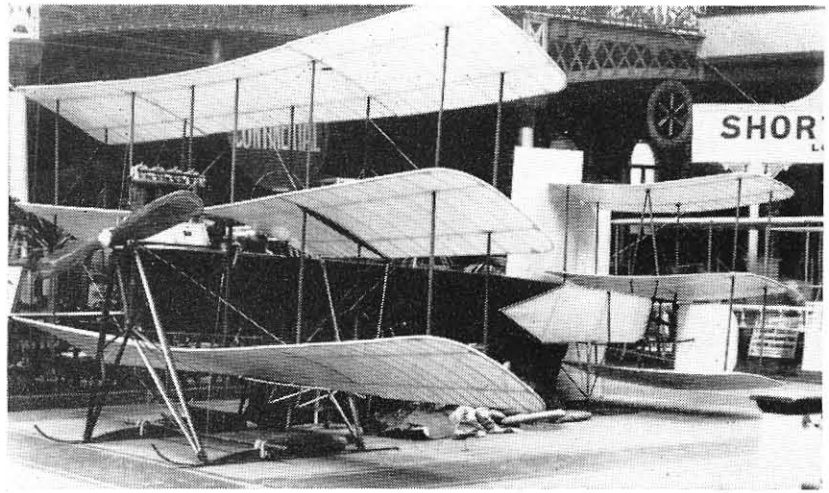
Power Plants: One 9 h.p. J.A.P.
One 20 h.p. J.A.P.

Dimensions: Span 20 ft. 0 in. Length 23 ft. 0 in.
Wing Area 285 sq. ft.
Tailplane span 10 ft. 0 in.
Tailplane area 35 sq. ft.

Weights: Tare weight 300 lb. All-up weight 450 lb.

Performance: Speed 25 m.p.h. Range 500 yards

Production: No. 1 Fitted with 2 cylinder 9 h.p. J.A.P., small fuel tank and tail wheel; preserved without engine or tail wheel at the Science Museum, South Kensington, London
No. 2 Fitted with 4 cylinder 20 h.p. J.A.P., raised cylindrical fuel tank and tail skid; wings and undercarriage modified 4.10; dismantled at Brooklands 5.10



The first Roe II triplane "Mercury" at the Olympia Aero Show, London, in March 1910 in its initial form with warping wings. (*'Flight' Photo.*)

Roe II Triplane

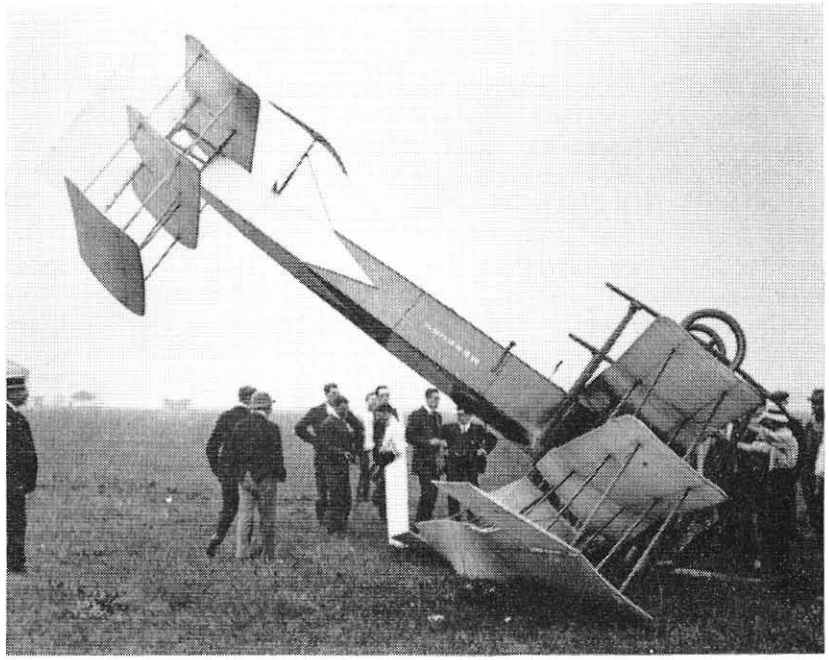
First product of the newly formed A. V. Roe and Company was a single seat triplane known as the Roe II. This was approximately equal in size to the original machine but was fitted with a 35 h.p. Green four cylinder, watercooled engine driving a birch two bladed, adjustable pitch airscrew. Cooling was by means of two spiral tube radiators built into, and fitting flush with, the sides of the front fuselage. The new triplane was structurally superior to its predecessors, with silver spruce struts and spars, and an ash fuselage covered with Pegamoid fabric. The undercarriage was a rigid triangulated structure to which the two-wheeled axle was secured by rubber shock absorber cord. Climbing and diving control was improved by pivoting the entire triplane tail and linking it to the mainplane variable incidence gear, the range of movement being from four to eleven degrees of incidence.

Named "Mercury", the first Roe II triplane occupied the place of honour at a model aircraft show at White City, Manchester, on March 4, 1910 and although it had not yet flown, was priced at £550 (with tuition). A week later it was again exhibited at the London Olympia Aero Show of March 11–19, where the Prince and Princess of Wales were shown round the machine by A. V. Roe and an order was received from W. G. Windham, later Sir Walter Windham M.P., a manufacturer of motor car bodies at Clapham Junction. References to the sale of yet another Roe II triplane to the Rangie Cycle Company appeared in several publications at the time but there is no evidence that such an aircraft was ever built.

The exhibition machine "Mercury" was retained by A. V. Roe for school and experimental use but when flight trials began at Brooklands, it rolled on take-off and twice landed upside down. The second crash (by pupil Job), on April 17, 1910, resulted in the destruction of the undercarriage and most of the mainplanes. During reconstruction Roe took the opportunity of correcting the C.G. position by moving forward the pilot's seat, and abandoned wing warping. The control column was remounted on a universal joint, large unbalanced ailerons were hinged to the trailing edge of the top wing, and a tall rectangular rudder more than twice the area of the original was fitted. Ten days were sufficient to complete this work and "Mercury" was out again for taxying trials on April 27.

W. G. Windham's aircraft was delivered to Brooklands early in May and assembled during Whitsun. First hops were made on May 26 by A. V. Roe who then handed it over to the owner for some preliminary taxying. The amount of flying done on this machine is uncertain but it is known that Windham landed in soft ground at Brooklands on July 12 and turned the triplane over on its back.

Accidents to "Mercury" were now much less frequent and on Thursday June 2, Roe made several circuits of Brooklands at a height of 20 ft. and



"Mercury" with ailerons fitted, after one of its several mishaps at Brooklands later in 1910. (*Photo courtesy of the Royal Aeronautical Society.*)

executed a number of fairly steep turns. At the end of July it was dismantled and taken to Weybridge Station along with its successor, Roe III, for despatch by rail to the Blackpool Flying Meeting of August 1, 1910. Hopes of winning the prize money so necessary for future experiments were dashed when sparks from the engine of the L.N.W.R. goods train set fire to their truck while puffing up an incline near Wigan on July 27. Both aircraft were reduced to ashes.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey.

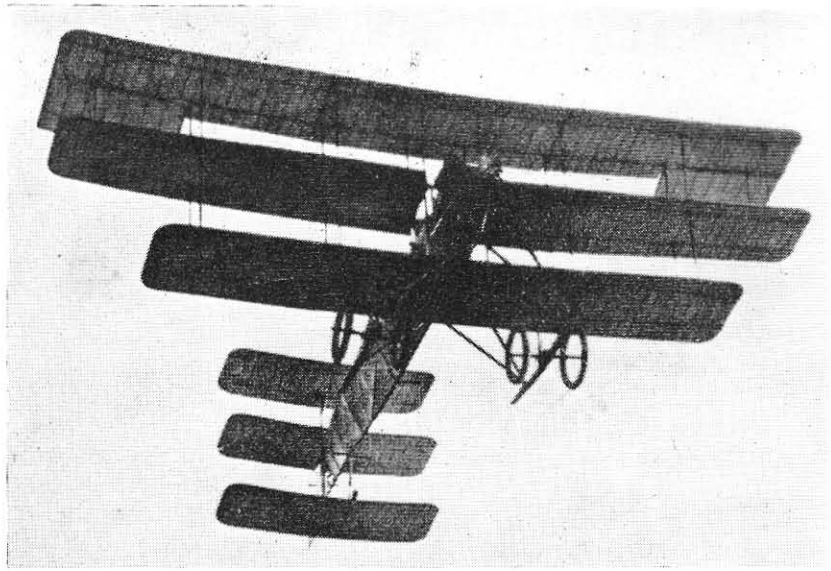
Power Plant: One 35 h.p. Green

Dimensions: Span 26 ft. 0 in. Length 23 ft. 0 in. Height 9 ft. 0 in.
Wing area 280 sq. ft.

Weights: Weight of engine without flywheel 150 lb.
All-up weight 550 lb.

Performance: Maximum speed 40 m.p.h.

Production: No. 1 "Mercury", Avro experimental, burned out near Wigan 27.7.10
No. 2 For W. G. Windham, Brooklands



The Roe III triplane (35 h.p. J.A.P.) in flight with ailerons fitted to the top wing. (*Photo courtesy of the Royal Aeronautical Society.*)

Roe III Triplane

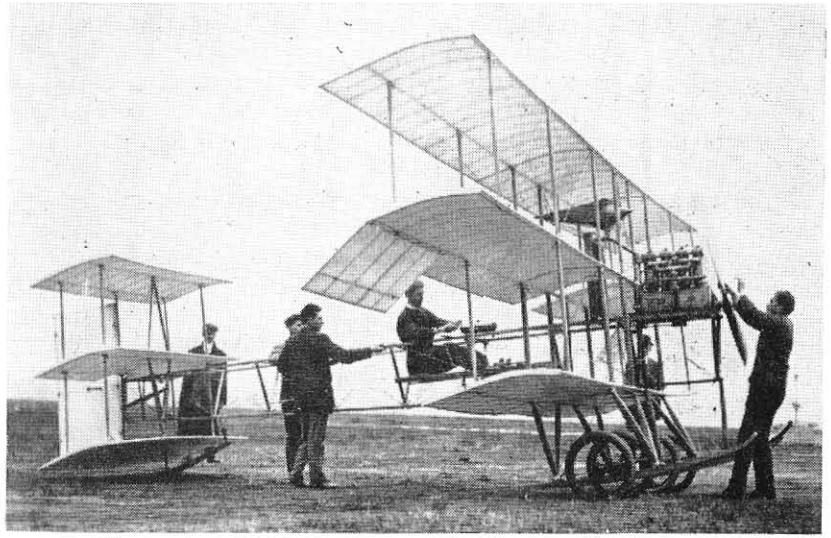
The 'prototype' Roe III was a two seater, structurally similar to Roe II, but with the important difference that the mainplanes were fixed to the fuselage, climbing and diving being effected for the first time by means of a tail elevator. The aspect ratio was 8 and the bottom wing was cut back to a span of only 20 feet. The lifting tail remained, but as a result of experiments with the triplane "Mercury", lateral control was by means of ailerons (5 ft. span × 2 ft. chord), this time hinged to the rear spar of the top wing so that they were slightly inset. By this time the functions of the rudder were better understood and this organ was increased in size to a rectangle equal in height to the maximum tailplane gap as on the modified Roe II. A more robust undercarriage was of the twin-skid, four wheel Farman type and the engine a 35 h.p. J.A.P. eight cylinder Vee aircooled unit.

First taxying trials were made at Brooklands by A. V. Roe on the evening of June 21, 1910 and the first straights were flown in a tricky wind on June 24. Flight times gradually increased until on July 4 he made a best flight of 11 minutes (with 'just a touch' after 3½ minutes) and later in the day carried his mother and several other passengers. Roe seldom exceeded 20 minutes in the air in the 'prototype' Roe III because the J.A.P. engine had a tendency to overheat and cover pilot and passenger with sooty oil ejected from the scavenging holes at the base of the cylinder walls. Carburettor fires were

frequent but Roe persevered until on July 9 he remained aloft for 25 minutes and made comparatively steep turns. He also practised figure eights in readiness for Royal Aero Club tests which he passed on this aircraft on July 20. Aviator's Certificate No. 18 was issued to the great pioneer on July 26, but within a year he had given up piloting in favour of designing and did not take the Air Ministry's 'A' Licence tests when they came into being in 1919. He kept no log books and did not know how many hours he had flown as pilot. The J.A.P. engined Roe III was advertised secondhand by the makers for £250 in May 1911 but its ultimate fate is uncertain.

The three subsequent triplanes of this type (all powered by 35 h.p. Green four cylinder, watercooled engines) had the span of the top mainplane increased to 31 ft. and were fitted with ailerons hinged to the rear spar of the centre wing. First of these, identified by rounded corners to the trailing edge of the rudder and by fuselage covering applied only in the region of the cockpits, was a special slow flying aircraft with a more heavily cambered wing section for instructional use at the Avro School. Piloted by the designer, this triplane first flew at Brooklands on July 9, 1910 and its performance was at once encouraging. Both Roe and Pixton carried passengers on July 13 and one another on the following day. At the end of the month the machine was sent by train from Weybridge to the Blackpool meeting only to destroyed by fire en route together with the Roe II "Mercury".

Determined to compete, Roe and Pixton hastily brought spare components from the Manchester works to Blackpool and arranged for a new engine to be



A. V. Roe seated in the 35 h.p. Green engined Roe III triplane at Squantum Point, Boston, U.S.A. in September 1911. (*Photo courtesy of H. F. Cowley.*)

delivered direct from the Green factory. Work started on Thursday July 28 and the finished aircraft flew on Monday August 1, much of the erection having been done by Roe himself during the previous night. There was not even time to cover the fuselage. Three attempts were made to take off, during which a tyre burst and some rubber shock absorbers snapped. Two struts were broken on landing but not before Roe had made four circuits of the course, at least two with passengers (who could face forward or backward according to taste). For this he received a special merit award of £50. August 2 dawned wet and windy but after repairs Roe succeeded in making two more short hops at 7.30 p.m. and on the following afternoon left the ground in a much more lively manner. In turning, the wind carried him dangerously close to one of the pylons, to avoid which he had no alternative but to make a crash landing, breaking several more struts, the airscrew and one mainplane.

Visitors to the Blackpool meeting included J. V. Martin, organiser of the Harvard University Aeronautical Society, who ordered a Roe III triplane which was built, crated and despatched (without engine) to the U.S.A. by August 13! A. V. Roe and Claude Grahame-White were also invited to fly at the Boston Aviation Meeting scheduled to open on September 2. They left in the White Star liner *Cymric* on August 23, Roe taking with him the makeshift Blackpool triplane in a 40 ft. packing case. Arriving at Boston on September 1, they collected the Harvard Society's triplane (which had been stored at East Boston Docks since its arrival in the Cunarder *Ivernia* a week previously), and took all the aircraft by lighter to the airfield at Squantum Point. Here Roe and mechanics Pixton and Halstead completed the erection of the Blackpool triplane on September 3, but flights begun on September 6 were disappointing, the longest being 75 ft. at a height of 10 ft. At 5 p.m. the engine failed and the triplane landed heavily in front of the grandstand, damaging the starboard mainplanes and undercarriage. Local woodworker C. H. Metz made a new airscrew and at 6.30 p.m. on September 8 Roe succeeded in leaving the ground properly for the first time, reaching a height of 30 feet. When he shut off the engine to land, however, a sudden gust caused the aircraft to swerve to starboard and dig the right undercarriage skid into the ground, causing it to swing round with major breakages. Roe was unhurt and more determined than ever to show the Americans that his triplanes were more than just interesting freaks. On September 9 he secured permission from Harvard to erect the Society's triplane and fit it with the 35 h.p. Green engine taken from the wreck. Erection was completed and engine runs made on September 12 and it is said that the aircraft was slightly heavier than its predecessor and had two instead of four wheels. Two days later, amid the applause of 10,000 spectators, successful flights were made up to a height of 50 feet but the engine still refused to give full power. After tinkering with it for most of September 15, Roe made a good take-off at 4.20 p.m. and flew the length of the field. In attempting to round the pylon, he sideslipped into the ground from 50 feet, totally wrecking the port side of the aircraft and suffering a severe scalp wound. A cordon of police

saved the wreck from souvenir hunters and after A. V. Roe returned to England, Pixton built a new triplane for Harvard out of the remains of the other two. He then sold the surplus spares to the local aircraft firm of Burgess and Co. and Curtiss of Marblehead to raise money for his passage home, leaving Harvard with their machine untested in the air.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey

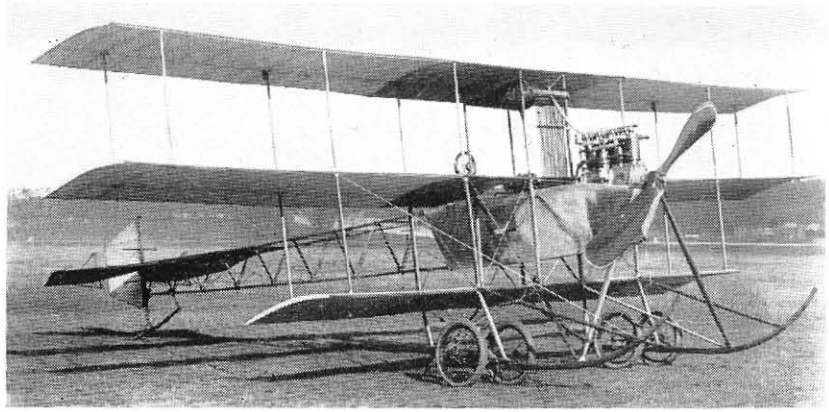
Power Plants: One 35 h.p. J.A.P.
One 35 h.p. Green

Dimensions: Span (upper) 31 ft. 0 in. (lower) 20 ft. 0 in.
Length 23 ft. 0 in. Wing area 287 sq. ft.
Tailplane area 75 sq. ft.

Weight: All-up weight 750 lb.

Production:
No. 1 Prototype with 35 h.p. J.A.P., first flown 24.6.10, up for sale 5.11
No. 2 Avro School machine, first flown 9.7.10, burned out 27.7.10
No. 3 Blackpool makeshift machine, first flown 1.8.10, crashed at Boston, U.S.A. 8.9.10
No. 4 Harvard Aeronautical Society machine, first flown (and crashed) at Boston, U.S.A. 15.9.10

Note: A work of reference of the period states that a triplane of this type was built for the great pioneer pilot Cecil Grace. This aircraft is conspicuous by its absence from contemporary records and diligent research by the author only makes it evident that no such aircraft existed.



The Roe IV triplane. (*'Flight' Photo.*)

Roe IV Triplane

The last of A. V. Roe's primitive triplanes, completed in September 1910, was a single seater structurally similar to its predecessors and powered by a 35 h.p. Green watercooled engine, the radiator for which was mounted in the centre section gap. The shortened bottom wing was retained but the wing chord was somewhat reduced. Despite the improved lateral control given by ailerons, the Roe IV Triplane reverted to wing warping, effected by rotating a control wheel mounted on a column which moved fore and aft for diving and climbing. The tailplane was triangular in shape and for the first time of the non-lifting monoplane type equipped with movable elevators. The familiar four wheeled undercarriage of the previous triplanes was also a feature of Roe IV.

By the middle of 1910 'A.V.' was fast becoming interested in building a biplane, with the result that only one Roe IV was constructed. It was used almost exclusively for instructional work at the Avro Flying School at Brooklands where pupils found it rather sensitive on the controls and more difficult to master than the earlier machines. Needless to say it was broken many times as on October 10, 1910 when, in the words of an onlooker, "a pupil rose unsteadily and after 225 yards slowly sideslipped into the sewage farm, completely smashing the starboard mainplane." Such incidents were so frequent that they excited little comment and the aircraft structure was so simple that even major damage could often be put right the same day.

Several famous pilots were trained on the Roe IV triplane, including Hubert Oxley and C. Howard Pixton, the former starting his training with a flourish by attempting to take off down wind without previous experience and nosing over in the sewage farm on October 17, 1910. Pixton, practising figure

eights at 200 ft. on November 8 for his Royal Aero Club certificate, sideslipped Roe IV into the ground, where it caught fire and suffered extensive damage. Nevertheless the machine was out again on November 17, back in the sewage farm by December 4 and carried Pixton successfully through the tests for his aviator's certificate on January 24, 1911. It continued to suffer at the hands of trainees such as F. Conway Jenkins, Gordon Bell, R. C. Kemp and Lt. W. D. Beatty, until the last mentioned slipped in and badly wrecked it on February 14, 1911. This time the damage took a fortnight to repair and the opportunity was taken to insert a four foot extension piece into the fuselage.

Pixton made the first test flight in the revised Roe IV on March 1 and managed to coax it up to 750 ft. This performance contrasted sharply with the usual 150 ft. ceiling associated with this machine. A week later on March 8, engine trouble compelled R. C. Kemp to abandon the tests for his certificate and soon afterwards (certainly no later than August 1911) the Roe IV was dismantled and replaced at the Avro School by the Type D biplane of superior performance.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey
Power Plant:	One 35 h.p. Green
Dimensions:	Span (upper) 32 ft. 0 in. (bottom) 20 ft. 0 in. Length 30 ft. 0 in. (increased to 34 ft. 0 in. February 1911) Height 9 ft. 0 in. Wing area 294 sq. ft.
Weights:	Airframe less engine 350 lb. All-up weight 650 lb.
Production:	One aircraft only, completed 9.10, withdrawn from use at Brooklands about 8.11



The original Avro Type D biplane with transverse radiator. (*'Flight' Photo.*

Avro Type D

In 1911 A. V. Roe abandoned the triplane configuration and designed a biplane which bore a close resemblance to the Roe IV. It was a two seater with triangular girder fuselage, twin undercarriage and the same type of cumbersome, triangular monoplane tail. This was replaced almost at once by one of rectangular shape. As on Roe IV, lateral control was by means of wing warping but the passenger seat was placed at the C.G. so that the machine could be flown solo without ballast. Power was supplied by a 35 h.p. Green, the radiator for which, placed vertically behind the engine at right angles to the direction of flight, distinguished this machine from later aircraft of the same type. It is probable that the engine was that knocked down to A. V. Roe for £67 10s. when the assets of the Scottish Aviation Syndicate were auctioned at Brooklands on December 17, 1910.

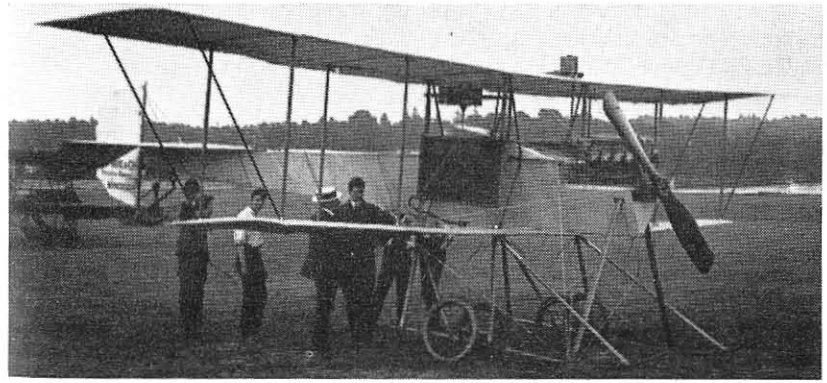
In later years aircraft of this type became known as the Avro Type D even though no reference seems to have been made to Types A, B, or C. These, of course, would have been designations posthumously applied to the early triplanes.

The first Avro Type D was erected at Brooklands in March 1911 and first flown on April 1 by C. Howard Pixton (who later took Mrs. Roe up in it). He declared it stable, viceless and easy to fly, characteristics confirmed by Gordon Bell and effectively demonstrated on April 11 by Lt. Wilfred Parke R.N. who, without having been in an aeroplane before, flew the length of the aerodrome. Numbered 1, it was flown in the Brooklands–Shoreham race by Pixton on May 6, 1911—the first event in which the Avro entry was not flown by the designer. Pixton lost time at the start because he was flying round

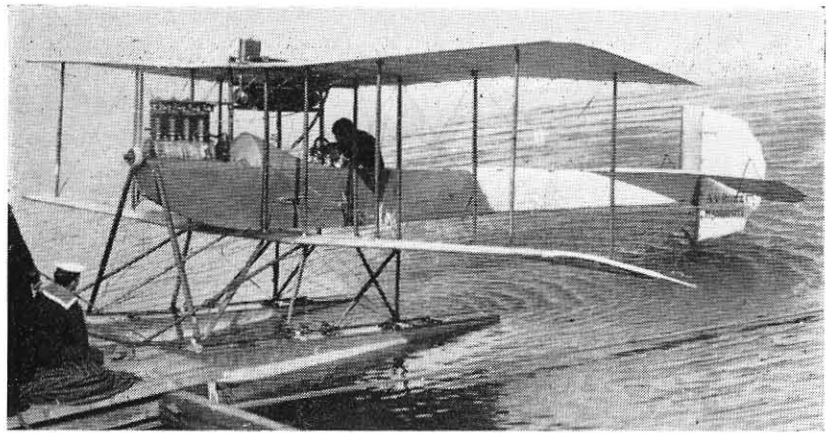
in an attempt to win the £500 Manville endurance prize with passenger. He had completed 26 minutes 30 seconds before noticing competitors taking off at the start of the race. He had no map, no cross country experience, and the Type D had never before been flown outside Brooklands Aerodrome. Nevertheless he made a hasty landing to refuel and set off after the others. He lost his way and took three hours for the trip, landing en route at Plumpton Racecourse, seven miles short of his destination. On the way back he spent two days at a flying demonstration at Oakwood, Haywards Heath, returning to Brooklands on Monday May 9 after a very turbulent trip via Dorking. On May 12 he flew the Type D to Hendon in 48 minutes to give a flying display before the Parliamentary Aerial Defence Committee, during which he carried the famous Cdr. Sampson R.N. as passenger and sent A. V. Roe solo in the machine for the first time. Pixton flew home to Brooklands next day and on May 19 made a nonstop flight of 1 hour 30 minutes towards the Manville prize. On June 11 the Type D climbed to a considerable height with the 12 stone Pixton and a 14 stone passenger.

After a flight at Brooklands in June 1911, Cdr. Schwann (later A.V.M. Sir Oliver Schwann K.C.B., C.B.E.) of the Naval Airship Tender *Hermione*, bought the Type D for £700. It was despatched by rail to Barrow-in-Furness where the original triangular tailplane was replaced, the wheels removed and the skids lashed directly to a series of float undercarriages designed by Schwann and his associates and built by naval personnel. The drag of the floats was partially offset by repositioning the radiator horizontally on top of the centre section and by covering the rear fuselage with fabric.

During first taxying trials on August 2 in the 9 ft. deep Cavendish Dock on Schwann's narrow, flat bottomed Mk. I floats, the aircraft assumed such a tail-down attitude on the water that the small tail float caused excessive wash. This and the fin were therefore removed and the rudder moved upward along



The special Type D with E.N.V. engine at Brooklands on the eve of the Circuit of Britain Race, July 1911. (*Photo courtesy of C. H. Barnes.*)

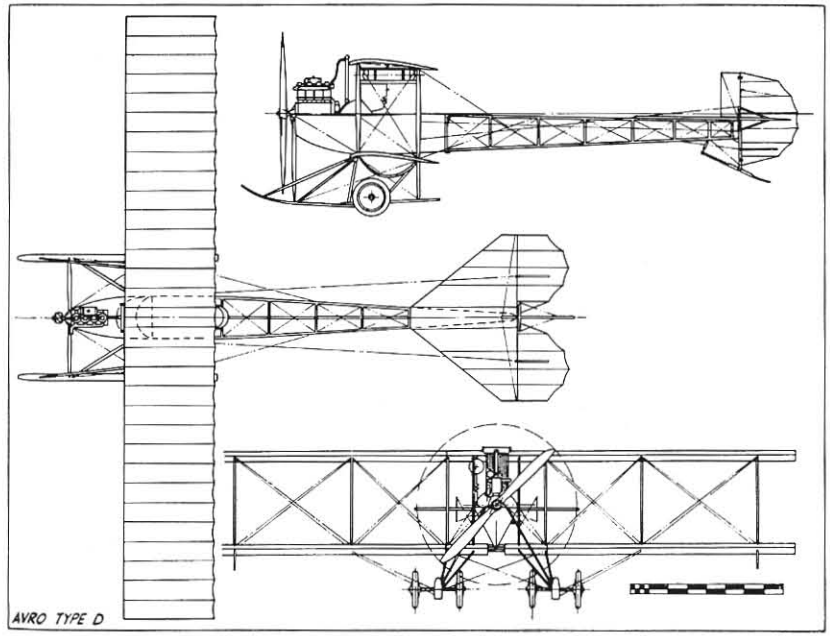


Cdr. Schwann with the Type D seaplane at Barrow-in-Furness, August 1911. (*Avro Photo.*)

the hinge line to clear the water. Later the rudder was raised still further till the lower edge was in line with the bottom of the fuselage. Maximum speed was only 18 knots and the machine eventually capsized. Report R. & M. 69 deals at length with Schwann's further experiments with seven different types of single and twin float undercarriages. Limited success came on November 18, 1911 after the Green Engine Co. Ltd. had coaxed an extra 10 h.p. out of the engine by fitting additional open exhaust ports, and float design had reached the Mk. VII stepped type. On that day the Type D lifted on to the step for the first time and left the water rather unexpectedly, reaching a height of 15–20 ft. Schwann was not at that time a qualified pilot and the aircraft fell back into the water and capsized. After salvage and reconstruction, trials were resumed by S. V. Sippe who made the first of a series of short flights at Barrow on April 9, 1912 during which he reported favourably on the feeling of acceleration from the unstick speed of 25 m.p.h. to the flying speed of 40 m.p.h. It became the first seaplane ever to take off from British sea water. On April 12 Sippe made two or three circuits of the dock and reached a height of 160 feet. The seaplane was then handed over to the owner who had just qualified as a pilot at the Bristol School on Salisbury Plain. The feasibility of marine aircraft had been proved but the rate of climb of the Type D seaplane was poor due to an increase in all-up weight to 1,000 lb. (an accurate figure obtained by weighing the machine in the airship shed at Barrow). Endurance was but 20 minutes—the time taken for the cooling water to boil away, so a 50 h.p. Gnome rotary was fitted in an attempt to improve the performance, but there are no recorded flights with this engine.

The sale of the Type D biplane reduced the Avro School to only one aircraft—the Roe IV triplane. Pending delivery of new machines from Manchester, A. V. Roe acquired a secondhand Gnome-engined Farman pusher purchased in Newcastle. The crates housing this relic were too big for railway trucks and travelled south by sea at a cost of £25. This charge contrasted sharply with that for Avro aircraft, which broke down into sections to fit into a single crate, the Manchester–Brooklands rail charge for which was a mere £1 16s. 6d.

The next Avro aircraft was a modified Type D built to compete in the £10,000 *Daily Mail* Circuit of Britain Race. It was a sesquiplane with upper and lower spans of 33 and 23 feet, powered by a 60 h.p. E.N.V. eight cylinder, watercooled engine. Like all subsequent machines of the type, its fuselage was increased in length from 26 ft. to 28 ft., but it was the only one, apart from the prototype, to be fitted with the large triangular tailplane. Construction took place at Manchester during June 1911 under the watchful eye of the pilot, R. C. Kemp, and first taxying trials were made at Brooklands by A. V. Roe on July 18. First flights made by Kemp later in the day showed the machine to be fast, but the engine overheated and the rate of climb was poor with full load of petrol and oil. Without A. V. Roe's approval, extensions were hurriedly fitted to the lower wing, making it equal in span to the upper and increasing the wing area by 50 sq. ft. After an initial test circuit at 100 ft. on July 22, morning of the race, Kemp climbed to 800 ft. but during a fairly



steep descent at half throttle the extension to the port lower mainplane failed at 150 ft. Although he jerked on full right rudder and full left warp, the machine spun into the ground wingtip first and broke up. Miraculously Kemp stepped unhurt from the wreckage.

The third Type D, the assembly of which was completed at Brooklands on September 9, 1911, was almost identical with the first but distinguishable from it because drag had been reduced by fitting the radiator in a sloping position behind the engine. Minor differences included straighter front skids, a covered fuselage and no fin. First straight hops were made by F. P. Raynham on September 11 and after adjustments a flight to 600 ft. was made on September 17. Although intended as a school machine, it was entered for the Michelin Speed Prize but during his flight to Hendon to compete on September 21, Raynham ran into thick fog. In attempting to 'press on' with primitive instruments, he made what may have been the first recorded spin and recovery, afterwards landing at New Barnet to ask his way. Unsatisfactory experiments with a new airscrew, and sagging wing fabric compelled him to give up the attempt. He therefore returned to base, arriving over Brooklands at 1,000 ft. on the evening of September 24 and by the end of the month the Type D was in full time use by the Avro School.

Delivered at Brooklands on September 30, 1911, the fourth Type D was a single seater but otherwise identical with the equal span school version, except for the radiator which was fitted vertically behind the engine in line with the direction of flight. The engine was a specially tuned Green giving 45 h.p. and identified by holes at the base of the cylinder walls which improved scavenging. After some trouble with slack fabric, satisfactory first flights on October 12 again raised Raynham's Michelin hopes and although he reached 1,000 ft. with 5 hours' fuel (13 gallons) during a practice flight two days later, bad weather on October 15, last day of the competition, ruined his chances. With an eye on the Michelin long distance prize, he coaxed the machine off on



F. P. Raynham seated in the fourth Type D at Brooklands in October 1911. (*Photo courtesy of C. H. Barnes.*)



The fifth Type D was the improved sesquiplane version. (*Photo courtesy of C. H. Barnes.*)

October 18 with 8 hours' fuel (24 gallons) but the attempt came to an abrupt end when the machine forced landed in the sewage farm with an iced-up carburettor on October 27, only three days before the closing date.

The fifth Type D was an improved sesquiplane version generally similar to, and having the same dimensions as, the ill-fated Circuit of Britain machine. The engine was a 35 h.p. Green.

The sixth machine was a single seater powered by a new 35 h.p. five cylinder Viale aircooled radial which had been delivered to A. V. Roe on September 30, 1911. The installation was done by Maurice Ducrocq (British concessionaire for Viale engines) and his apprentice Jack Alcock. Work was completed on October 6 but it was not until November 20 that first flights were made by F. P. Raynham. The Viale-powered Type D proved very manœuvrable and flew strongly in the hands of a number of school pilots. On December 6 Raynham used it for joyriding by removing the fuselage petrol tank to make room for a passenger to kneel facing him. On December 27 Wilfred Parke climbed the machine to 2,500 ft. over Addlestone as a prelude to his 'Superior Brevet' tests and S. V. Sippe gained his Aviator's Certificate on it on January 8, 1912. During at attempt to fly to Oxford as part of his tests on January 13, Parke followed the Thames until poor visibility forced him down at Abingdon where he broke two bracing wires. On the following morning the machine was dismantled in 65 minutes and temporarily stored in a local garage. No later flights by this machine are recorded and its Viale engine was installed in the Avro Type F cabin monoplane in the following April.

The precise number of Type D biplanes produced by the Manchester works was never made known. None was built after 1912 and advertisements making a special offer of 12 Type Ds at a reduced price of £400 each during October and November 1911 can only be regarded as a publicity stunt. There is no evidence that any orders were placed.

In October 1912 the Avro School moved from Brooklands to the new aerodrome at Shoreham-by-Sea, Sussex, and became the Avro Flying School

(Brighton) Ltd. with A. E. Geere as C.F.I. Last noteworthy flights before the transfer were made in mid-August by Wilfred Parke in the old sloping radiator Type D to Staines, Ripley, Hounslow Heath and Walton. The machine was used for instruction at Shoreham during 1913 and became well known along the South Coast as did the school's 45 h.p. Green engined Type D, Type D with 50 h.p. Isaacson seven cylinder radial, and the Avro Type E prototype described later.

It is unlikely that the sixth Type D, undamaged in the Abingdon forced landing, would have been scrapped after the removal of the Viale engine. It seems more probable that its front fuselage, already modified for radial engines, invited the installation of a more powerful unit. In the absence of definite proof it can reasonably be assumed that this was the Isaacson machine.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; Brooklands Aerodrome, Surrey; and Shoreham Aerodrome, Sussex

Power Plants:
One 35 h.p. Green
One 45 h.p. Green
One 35 h.p. Viale
One 50 h.p. Isaacson
One 60 h.p. E.N.V. Type F

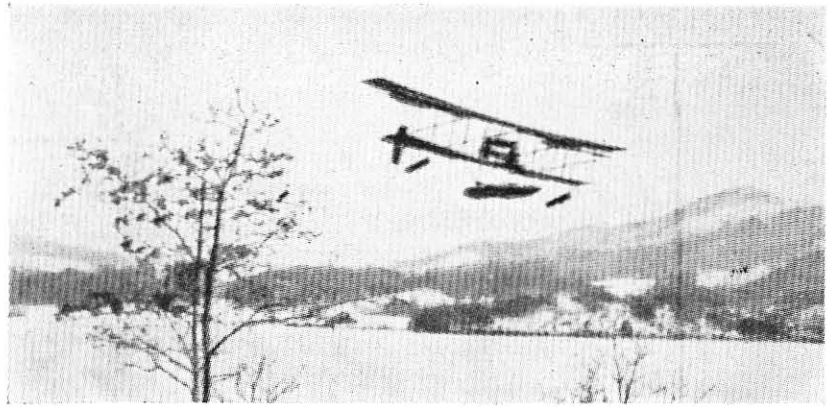
Dimensions, Weights and Performances:

	Standard	Seaplane	Sesquiplane
Span, upper	31 ft. 0 in.	31 ft. 0 in.	33 ft. 0 in.
Span, lower	31 ft. 0 in.	31 ft. 0 in.	23 ft. 0 in.
Length	28 ft. 0 in.*	26 ft. 0 in.	28 ft. 0 in.
Height	9 ft. 2 in.	—	9 ft. 2 in.
Wing area	310 sq. ft.	310 sq. ft.	279 sq. ft.
All-up weight	500 lb.	1,000 lb.	550 lb.
Speed	45–50 m.p.h.	40 m.p.h.	—
Range	100 miles**	—	—

*Prototype 26 ft. 0 in. **With Viale engine.

Production:

No. 1 Prototype, 35 h.p. Green, transverse radiator, first flown 1.4.11, converted to seaplane, last mentioned 4.12; No. 2 Circuit of Britain machine, E.N.V. engine, first flown 18.7.11, crashed at Brooklands 22.7.11; No. 3 School machine, 35 h.p. Green, slanting radiator, first flown 11.9.11, withdrawn from use at Shoreham 5.14; No. 4 Single seater, 45 h.p. Green, fore-and-aft radiator, first flown 12.10.11, withdrawn from use at Shoreham 5.14; No. 5 Improved sesquiplane, believed that advertised for sale at Shed 4, Brooklands, 5.12 and that reported scrapped near the petrol store 12.12; No. 6 School machine, Viale engine, first flown 20.11.11, almost certainly re-engined with 50 h.p. Isaacson, withdrawn from use at Shoreham 5.14



Capt. E. W. Wakefield's Avro-Curtiss seaplane flying over Windermere, January 1912. (*'Manchester Guardian' Photo.*)

Avro Curtiss-type

In the summer of 1910 A. V. Roe and Company declared its willingness to build aeroplanes to other people's designs and the first such aircraft was a Farman-type biplane for a Bolton business man. Bolts, fittings and bracing wires were also supplied to Miss Lilian Bland who built and flew the Mayfly biplane of her own design at Carnamony, Belfast. Each of these aircraft was fitted with one of the few examples of the 20 h.p. two cylinder, horizontally opposed, aircooled Avro engines. The Farman-type evidently did not meet with much success as 18 months later, at the end of 1912, the engine and airframe were advertised for sale in new condition for £45 and £60 respectively.

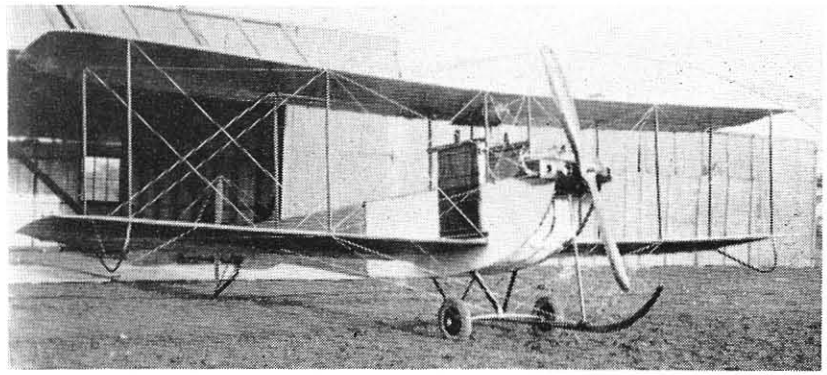
A Curtiss-type, of the familiar outrigger-tail and front-elevator variety with 50 h.p. Gnome rotary, was built in 1911 to the order of Capt. E. W. Wakefield of Kendal. Neither this nor the Farman-type mentioned above was given an Avro designation. Mainplanes were of unequal span and lateral control was by four ailerons on the upper mainplane, the inner and larger pair having semi-circular trailing edges. It was built at Manchester and delivered at Brooklands for test flying on May 19, 1911. After a period with the Avro School during which it was flown by F. P. Raynham, R. C. Kemp, F. Conway-Jenkins and Louis Noel, the Avro-Curtiss was transferred to Lake Windermere where Capt. Wakefield replaced the wheels by a single 12 foot, three step, canvas covered mahogany float built by Messrs. Borwick and Sons of Bowness-on-Windermere. Small cylindrical floats were mounted below the wingtips and the aircraft made its first flight in marine form from Windermere as the "Lakes Water Bird" on November 25, 1911. The pilot was H. Stanley-Adams, a former pupil of the Avro School. Water Bird was

the first consistently successful seaplane in the United Kingdom and during the next few months its fame spread quickly and a considerable waterborne joyriding business was done. Sixty flights were made in the first 38 days, the best being of 20 minutes duration up to a height of 800 ft. On December 7, 1911 Stanley-Adams flew the whole length of the lake at a speed of approximately 40 m.p.h. These operations continued throughout the winter, but the night of March 29–30, 1912 brought gales which demolished the lakeside hangar at Cockshott and damaged "Water Bird" beyond repair. Its float, tailplane and rudder (the last still proudly displaying the legend "A. V. Roe and Company, Manchester") are still in the possession of the Wakefield family at Windermere.

Water Bird's successor, identical, but entirely designed and built at Windermere by Capt. Wakefield's Lakes Flying Company later in 1912, was known as "Water Hen". Its only Avro component was the airscrew and at first it could be distinguished from its Avro-built forerunner by the wingtip floats and straight trailing edges to the ailerons. These were mounted parallel to the chord line of the mainplanes instead of at a considerable angle to it. They were later remounted in the angled position but by that time more drastic modifications had been made and all similarity to Water Bird ceased.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey
Power Plant:	One 50 h.p. Gnome
Dimensions:	Span (upper) 41 ft. 0 in. (lower) 32 ft. 0 in. Length 36 ft. 5 in. Wing area 365 sq. ft.
Weights:	Tare weight 780 lb. All-up weight 1,130 lb.
Performance:	Maximum speed 45 m.p.h. Ceiling 800 ft.
Production:	One aircraft only, first flown as landplane 5.11; first flown as seaplane 25.11.11, damaged beyond repair at Cockshott, Windermere 30.3.12



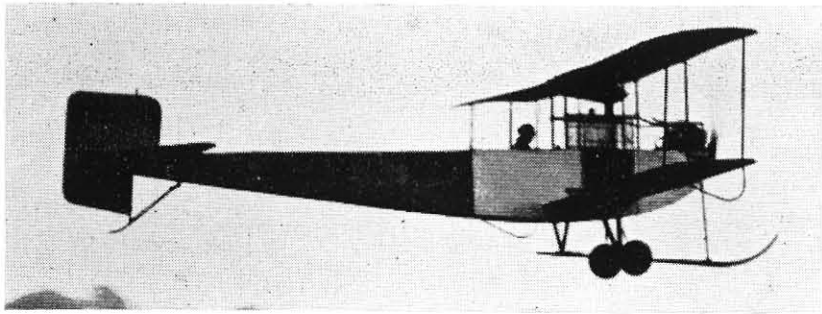
The Duigan biplane in its original form with 40 h.p. horizontally opposed Alvaston engine. (*Photo courtesy of W. Duigan.*)

The Duigan Biplane

John R. Duigan was an Australian who designed and built a Farman-type biplane at Mia Mia, Victoria in 1910 and flew it before a very large crowd at Bendigo Racecourse, Melbourne on May 3, 1911. A series of accidents convinced Duigan that he needed proper flying instruction and later in the year he sailed for England, arriving in October 1911. He went at once to Brooklands, joined the Avro School, placed an order for a private Avro aeroplane and in the following month went off to Manchester to see it built.

The machine was a two seat, dual control biplane, similar to Type D but fitted with a square rudder, steel framed tailplane and square instead of triangular section fuselage. The seats were arranged so that the occupants' heads were raised just above the padded rim of an elliptical opening and celluloid windows were provided in the floor to give downward view. Following current Continental practice, Roe tried a newer wing section having 'Phillips entry' whereby the chord line of the wing was horizontal in level flight. Wing warping was employed for lateral control and wing spars were of English ash with poplar ribs, rounded wingtips being formed from rattan cane. As usual, the whole machine was built in sections, easily dismantled for transport, the fuselage consisting of two halves bolted together behind the rear cockpit. The engine was a 40 h.p. horizontally opposed Alvaston driving an Avro airscrew of Kauri pine and cooled by large spiral tube radiators on each side of the front cockpit.

The undercarriage was a complete departure from normal Avro practice, incorporating a Nieuport-type leaf-spring axle and centre skid with bracing wires to flatten long grass and prevent nosing over. This type of undercarriage proved so successful that in modified form it was used on Avro aeroplanes for a generation.



J. R. Duigan flying the biplane with 35 h.p. E.N.V. engine at Brooklands April 1912. (*Photo courtesy of W. Duigan.*)

First straight hops were made by Duigan at Huntingdon Racecourse flying ground early in February 1912 but in spite of experiments with different airscrews the machine was very loath to leave terra firma. Considering it advisable to return to the Avro fold, Duigan took the machine to Brooklands where a 35 h.p. E.N.V. engine was fitted and he met with more success. On March 10 several long straight flights were made but the aircraft was sadly underpowered and only flyable in good weather. Duigan then made and fitted an airscrew of his own design and working as his own mechanic, tuned the E.N.V. engine to such good effect that on April 12 he succeeded in flying several times round Brooklands track. On April 19 he flew figure eights at 300 ft. and on April 27 successfully completed tests for his Aviator's Certificate, the aircraft having completed four hours in the air up to that date entirely without damage. Passenger flights, not so successful on low power, were confined to straights within Brooklands track. Duigan's best and final solo flight in his machine, consisting of an hour's circuits over Addlestone at an altitude of 400–600 ft., was made on April 30.

Having achieved his objectives, Duigan returned home. There he built a very similar machine to the Avro which crashed on its first flight on February 17, 1913. His British aeroplane was put up for sale with engine for £380 but was almost immediately reduced to £180, no doubt because the engine had been sold separately. The airframe was purchased by the Lakes Flying Company who rebuilt it at Windermere as the centre float seaplane Sea Bird which H. Stanley-Adams flew off the lake for the first time on August 28, 1912. The company entirely redesigned the front end of the fuselage to accept a 50 h.p. Gnome rotary, the upper half of which was cowled and gave a cocked-up appearance to the nose. New three bay, warping mainplanes of Eiffel 12 section and 8·5 aspect ratio were also fitted. The machine proved much faster than the old Avro-built Water Bird and after it had been fitted with an improved twin float undercarriage, carried large numbers of holiday-makers during 1912-13. Dual control was fitted in 1915 but Sea Bird was destroyed in June of that year when pupil R. Buck spun in from 300 ft.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey
Rebuilt by The Lakes Flying Company, Cockshott, Lake Windermere, Westmorland

Power Plants: (Duigan) One 40 h.p. Alvaston
One 35 h.p. E.N.V. Type D
(Sea Bird) One 50 h.p. Gnome

Dimensions: (Duigan) Span 34 ft. 0 in. Chord 4 ft. 6 in.
(Sea Bird) Span 39 ft. 4 in. Length 29 ft. 4 in.
Height 10 ft. 6 in. Wing area 350 sq. ft.

Performance: (Duigan) Speed 40 m.p.h.
(Sea Bird) Maximum speed 62 m.p.h.

Production: One aircraft only, first flown 2.12; converted into the Lakes Sea Bird 10.12, crashed at Windermere 6.15



The Avro Type E prototype with 60 h.p. E.N.V. engine. (*'Flight' Photo 029.*)

Avro 500 (Type E)

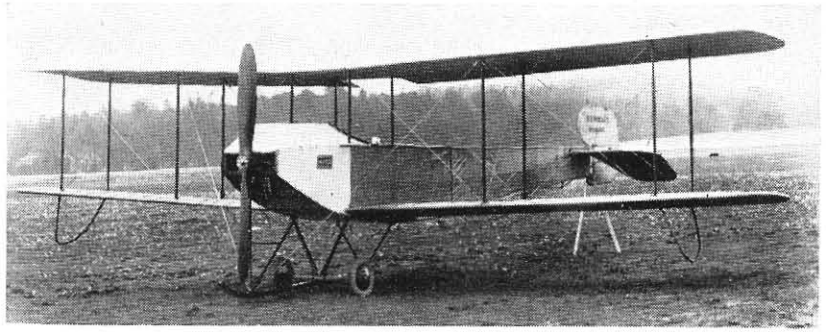
The first War Office military aircraft specification, issued in 1911, called for a two seater to carry a 350 lb. load in addition to essential equipment and have an endurance of 4½ hours, initial rate of climb of 200 ft./min., maximum speed 55 m.p.h., ability to maintain 4,500 ft. for one hour, and be capable of delivery to Salisbury Plain in a crate. Competing firms had only nine months in which to design, build and test.

A. V. Roe and Company met this specification by building a new two seat biplane, very similar in design and construction to the previous year's Duigan machine. The built-up box-girder fuselage was again of square section, fabric covered in the rear and metal clad forward. It was more streamlined than the Duigan with pilot and passenger seated at the widest part with their heads protruding through padded openings in the top. Small celluloid panels were again provided in the floor to give downward vision. The mainplanes used ash spars and an improved, double-surfaced section covered with Pegamoid fabric. They were detachable in three sections for ground transport. The undercarriage was of the Duigan type with centre skid and leaf-spring axle, the tail being carried on a rubber-sprung skid.

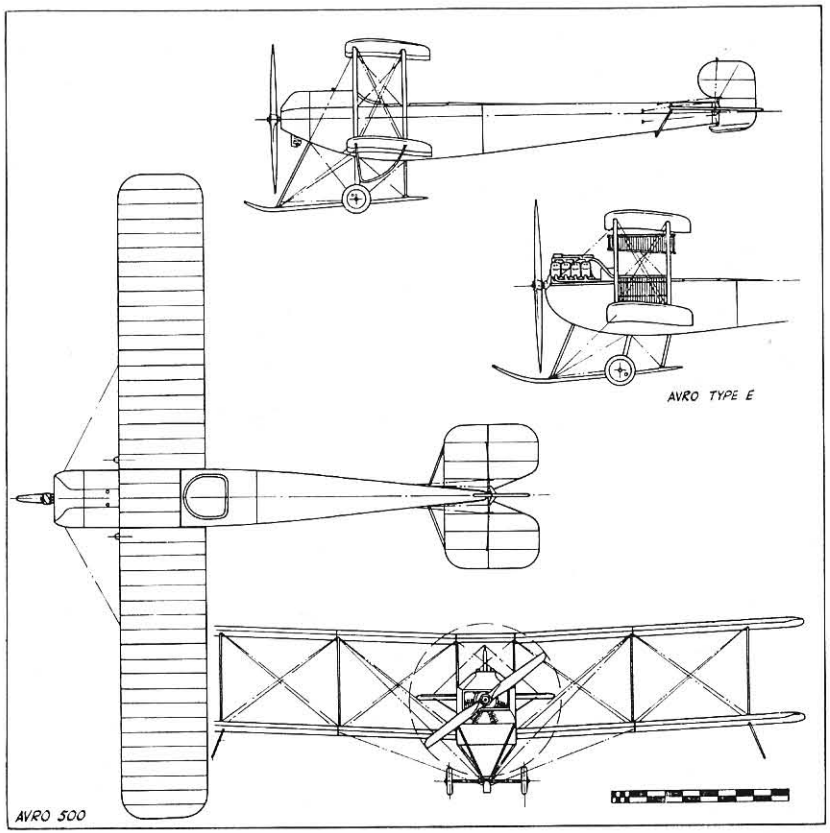
A 60 h.p. E.N.V. watercooled engine was mounted on the top longerons and drove a 10 ft. Avro airscrew. The main fuel tank was in front of the passenger and twin gravity tanks were fixed to the centre section struts. Known originally as the 'Military Biplane', but in later years as the Type E prototype, the machine was first flown at Brooklands by Wilfred Parke on March 3, 1912. It was obvious from the outset that this was no ordinary aircraft but one with that rare quality, a reserve of power. This encouraged its entry for the Mortimer Singer prize. Test flying took but a few days, during which it was promptly dubbed "Elinor Glyn" (after a well-known novelist of the period) and on March 23 Parke climbed to 1,000 ft. in under six minutes and to 2,000 ft. in 13 minutes with a heavy passenger (R. L. Charteris).

Cooling was by spiral tube radiators on each side of the front fuselage, augmented by two smaller units on the centre section struts on each side of the passenger's head. On April 20 Parke suffered partial engine failure when taking off for Hendon to compete for the prize. The hurried landing ripped off undercarriage and mainplanes and when the aircraft rolled on its side the auxiliary radiators folded over the front cockpit and engineer W. H. Sayers had to be extricated through a hole cut in the side. In the interest of future passengers the machine was rebuilt with only the lower radiators fitted. Parke successfully piloted the machine through Farnborough trials in June 1912 after which it returned to Brooklands to become a flying testbed for the new 60 h.p. A.B.C. engine. First straight hops with this power unit were made by F. P. Raynham on August 31 but it was not until October 18, when several engine and airframe adjustments had been made, that it flew strongly in the hands of the A.B.C. representative R. L. Charteris. In 1913 the E.N.V. engine was reinstalled and the aircraft sent to Shoreham and there flown by experienced pilots of the Avro School, such as H. R. Simms and H. S. Powell. On June 29, 1913 pupils were allowed to fly it for the first time but in the afternoon it stalled on a turn, crashed and was destroyed by fire. Pilot R. N. Wight received fatal injuries, the first ever in an Avro aircraft.

Although he had created a remarkable aeroplane, A. V. Roe was not altogether satisfied. He therefore built an almost identical machine and fitted the 50 h.p. Gnome seven cylinder rotary taken from the superannuated Avro School Farman when it was dismantled in November 1911. The Gnome, only a fraction of the weight of other engines of similar power, gave the machine a much enhanced performance and during first flights at Brooklands by Parke on May 8, 1912 the machine reached 2,000 ft. in five minutes. The next day he flew 17 miles to Laffan's Plain in 20 minutes and completed all official trials the same afternoon. Officialdom was impressed and after some haggling over price, the War Office bought it and ordered two others with dual control. One of these is said to have been tested to destruction under ground load, but recent researches make it clear that the Avro 500



The Avro 500 prototype with 50 h.p. Gnome rotary engine and the original sprung rudder. (*'Flight' Photo 044.*)



in question was merely proof loaded as part of the acceptance trials.

A. V. Roe always regarded the Gnome powered Type E as his first really successful aeroplane. Dismissing all previous machines as mere experiments he gave it the imposing type number 500, first of the Avro series which continues in use until the present day.

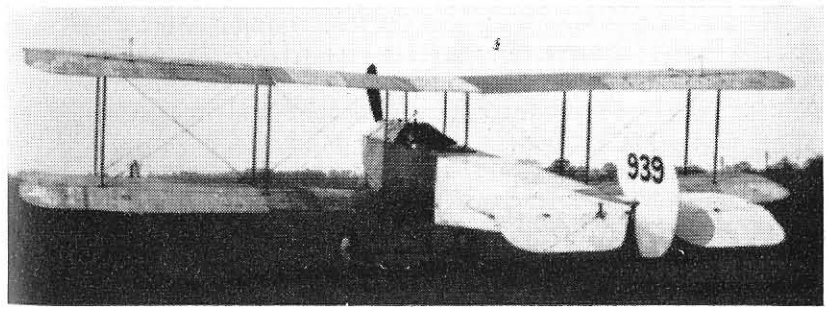
Wilfred Parke first flew the second Avro 500 at Brooklands on June 5, 1912 and delivered it to Farnborough in 23 minutes later in the day. Although so many Avro aircraft had first seen the light of day in Manchester, the inhabitants of that city had not at that time seen one in the air. To remedy this the third Army machine was 'borrowed' on June 28, taken from the factory to Eccles Cricket Ground and next day flown over Chorlton by Parke. Flights were made from Old Trafford over the Docks on the following day and from Fallowfield on July 5. After minor repairs the machine was then flown to Brooklands for normal flight test by Parke (with Gordon Bell as passenger) on July 19 before delivery by Raynham on July 22. The three Avro 500s joined the strength of the Central Flying School, Upavon, with serial numbers *404*, *405* and *406*. They were flown by pilots who later became

famous, such as Maj. Brooke-Popham (later Air Chief Marshal Sir Robert Brooke-Popham, Governor of Kenya) and Lt.-Col. Cook R.A. who made a notable flight to Portsmouth in *404* on August 8, returning via Lee-on-Solent (50 miles) in 40 minutes on August 17. The Avro 500 rapidly established itself as the best available trainer, resulting in a further order for four two seaters in November 1912 and another for five single seaters to equip No. 3 Squadron, Netheravon, in January 1913.

Years of endeavour were being rewarded. To A. V. Roe fell the honour of escorting H.M. King George V round the second machine of the two seater batch at the Olympia Aero Show of February 14–22, 1913. With total orders at the dozen mark the firm had become sufficiently stable financially to re-form as a limited company on January 11, 1913 and to move into larger premises at Clifton Street, Miles Platting, Manchester in the following April. War Office orders were completed in June 1913 (the penultimate single seater was tested at Shoreham by F. P. Raynham on June 12) and later in the year six others were supplied to the Air Department of the Admiralty. These were stationed at Eastchurch, where the first, *41*, was commissioned in August and the second, *51*, passed its one hour acceptance tests on September 25, 1913. The pilot was Raynham with Lt. J. W. Seddon, Inspector of Naval Aircraft, as passenger. Deliveries ended with *150* in April 1914.



J. Laurence Hall in the 'civil' Avro 500 at Hendon in January 1914. Typical of late production 500s it had the 'comma' rudder and inversely tapered ailerons. (*'Flight' Photo.*)



The Hall School's Avro 500 at Hendon late in 1914 on war service as *939* with improved undercarriage. (*Photo courtesy of the Royal Aeronautical Society.*)

During the short Service life of the Avro 500, several important modifications were made. The prototype had no tail skid and depended on a steel shoe screwed to the bottom of the rudder. It was a weak arrangement and the rudder was redesigned to absorb landing shocks by sliding vertically up the kingpost against the action of a coiled spring. By mid-1913 this still somewhat hazardous system had been abandoned in favour of an ordinary bungee-sprung tail skid and the now-famous comma-shaped Avro rudder. Lateral control on all War Office single and two seat Avro 500s was by wing warping but modified outer wing panels incorporating inversely tapered ailerons on top and bottom wings were fitted later. At least *406* was further modified with constant chord ailerons, while in several instances the looped wing tip skids were replaced by braced bamboo rods with, or without, a small wheel at the tip.

A few Avro 500s remained in commission throughout the early years of the First World War and one was locally re-engined at Chingford with a 100 h.p. Gnome 14 cylinder rotary.

There were at least three other Avro 500s in addition to War Office and Admiralty machines. The first, of the sprung rudder type, was built for the Portuguese Government and paid for by public subscription. Despatched to Lisbon in September 1912 in charge of H. V. Roe, Copland Perry (pilot) and W. H. Sayers (engineer), it was unloaded on October 7 and conveyed by bullock cart to the flying ground at Belem. It was erected and flown on successive days, after which trial flights were made up the Tagus to Lisbon with the name "Republica" in large red letters on the fuselage and in green under the mainplanes. The machine was handed over to the Minister of War before 20,000 people on October 16 but the next day Perry just failed to reach the aerodrome when an exhaust valve on the Gnome jammed open. He put the Avro down gently in shallow water from which it was salvaged without damage, cleaned down, greased and stored for the winter.

The best known of all Avro 500s was probably that flown by F. P. Raynham to the Burton-on-Trent Meeting of August 2–5, 1913 during which he carried numerous passengers and won the quick starting and cross country races. As if to underline the fact that this was no 'stick and string' freak, Raynham flew the machine south to Brooklands after the meeting and on August 9 raced it from scratch into second place in the six laps speed race at the Hendon August Meeting. Raynham then became so fully engaged in demonstrating the new Avro 504 prototype that the faithful 500 languished at Brooklands until he was free to give dual instruction to H. V. Roe and C. F. Lan-Davis. The latter bought the machine in December 1913 and gained his Aviator's Certificate on it on March 24, 1914. He first kept the machine at Brooklands but it was later based at Hendon where Lan-Davis fitted an elaborate array of instruments. He also attempted to mass balance the elevator by fitting broomsticks which projected forward at each end.

The other 'civil' Avro 500, delivered Brooklands–Hendon by F. P. Raynham on January 22, 1914 was used for display and instruction by J.

Laurence Hall whose name appeared large on the fuselage. Two months later Hall succeeded in looping the machine to show that standard British aircraft were quite as manœuvrable as the special lightweight French machines of the period. He flew hundreds of trouble-free hours in it and made numerous cross country flights including a 45 minute trip from Shoreham to Hendon with a lady passenger on July 14. An order for four Avro 500s by the Royal Aero Club was frustrated by the outbreak of the First World War but the Hall machine continued in instructional use at Hendon until commandeered by the War Office in September 1914. It remained in the same employ but carried serial *939* and in common with other surviving Avro 500s, was fitted with a twin skid undercarriage and oversize wheels.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company (reconstituted as A. V. Roe and Co. Ltd., 11.1.13), Brownsfield Mills, Great Ancoats Street, Manchester (moved to Clifton Street, Miles Platting, Manchester, 4.13); and at Shoreham Aerodrome, Sussex

Power Plants:
(Type E prototype) One 60 h.p. E.N.V. Type F
One 60 h.p. A.B.C.
(Avro 500) One 50 h.p. Gnome
One 100 h.p. Gnome

Dimensions:
Span 36 ft. 0 in. Height 9 ft. 9 in.
Length (Type E prototype) 30 ft. 6 in.
(Avro 500) 29 ft. 0 in.
Wing area 330 sq. ft.

Weights:
(Type E prototype)
Tare weight 1,100 lb. All-up weight 1,650 lb.
(Avro 500) Tare weight 900 lb. All-up weight 1,300 lb.

Performance:
(Type E prototype)
Maximum speed 50 m.p.h.
Initial climb 170 ft./min. Endurance 6 hours
(Avro 500) Maximum speed 61 m.p.h.
Initial climb 440 ft./min.

Production:

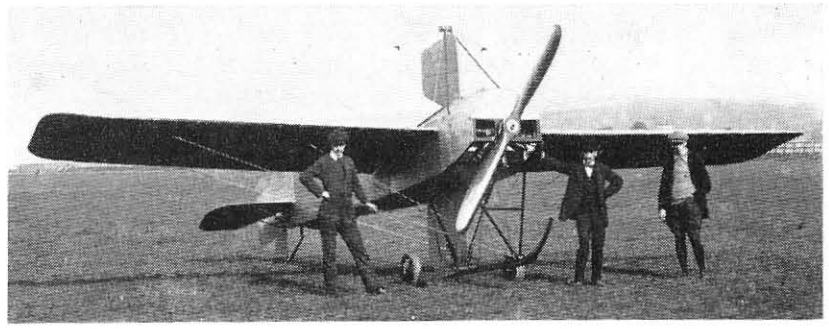
Type E

Prototype only, first flown at Brooklands 3.3.12, destroyed by fire at Shoreham 29.6.13

Avro 500

Two seaters to War Office Contract May 1912: *404* and *405* first flown at Brooklands 8.5.12 and 5.6.12 respectively, delivered to Farnborough 9.5.12 and 5.6.12, thence to C.F.S., Upavon; *406* first flown at Manchester 28.6.12, to Farnborough 22.7.12, thence to C.F.S., Upavon. Two seaters to War Office Contract December 1912: *430*, *432*, *433* and *448* to C.F.S., Upavon. Single seaters to War Office Contract January 1913: *285* and *288–291* to No. 3 Squadron, Netheravon 1913, to Farnborough 1914. Two seaters to Admiralty Contract

1913: *41* delivered to Eastchurch 8.13, crashed at Eastchurch 7.3.14; *51* to Eastchurch 25.9.13, later to Hendon, written off 11.8.15; *52* to Eastchurch 10.14, to Hendon 12.14, at Chingford 1916 with 100 h.p. Gnome; *53* at Eastchurch 1916; *94* no information; *150* to Eastchurch 4.14. Other two seaters: 1. For the Portuguese Government, delivered at Lisbon 16.10.12 2. Demonstrator, first flown 7.13, sold to C. F. Lan-Davis 12.13, awaiting more powerful engine at Hendon 8.14 3. To J. L. Hall, Hendon 22.1.14, commandeered 9.14 and allotted R.F.C. serial *939*



The Burga monoplane at Shoreham in November 1912. (*Photo courtesy of C. H. Barnes.*)

The Burga Monoplane

In 1912 A. V. Roe and Company built a shoulder-wing monoplane to the designs of Lt. Burga of the Peruvian Navy, who wished to try out some highly original ideas on aircraft control. The machine was constructed at Brownsfield Mills at the same time as the Avro Type E prototype and used the same tail and undercarriage, but the fuselage was much slimmer and the engine a 50 h.p. Gnome rotary. It is probable that the Burga monoplane was, in fact, the Avro 502 of which no details survive except that it was a single seat monoplane.

Rectangular monoplane wings were wire braced to strong points on the undercarriage and to a pylon built above the fuselage. There was no wing warping, lateral control being obtained by two 'rudders', one above and one below the fuselage, working in opposite directions. The design made provisions for wings of varying camber which fitted at varying angles of incidence to give the machine any desired performance.

Lt. Burga took a shed at Shoreham where the machine was test flown on November 20, 1912 by H. R. Simms. The mainplanes fitted were those best suited for maximum speed and the pilot reported that it was certainly fast and had a good rate of climb. Further taxying trials were made by H. S. Powell in the following month, and in January 1913 the Burga monoplane returned to the Avro works at Manchester for modification.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Shoreham Aerodrome, Sussex
Power Plant:	One 50 h.p. Gnome
Dimensions:	Length 29 ft. 0 in.
Production:	One aircraft only, first flown at Shoreham 20.11.12



The Avro Type F cabin monoplane showing the famous 35 h.p. Viale radial engine which is now preserved for all time. (*'Flight' Photo 09.*)

Avro Type F

In the spring of 1912 A. V. Roe's fertile mind conceived the idea of an enclosed aeroplane affording the occupants complete protection from the elements. He straightway designed two such machines, the first of which was a single seat, mid-wing monoplane known as the Type F.

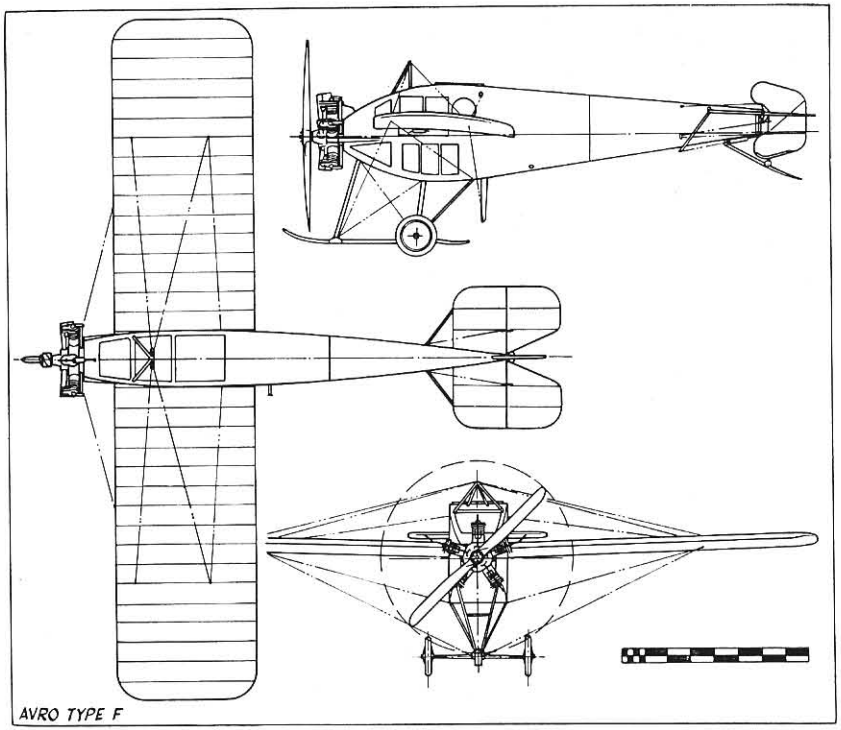
Structurally similar to the Avro 500, it used the same undercarriage, tail unit and small rudder (this time linked to a steerable tail skid), but there the similarity ended. The box-girder fuselage was of streamlined shape built up from four wooden longerons and cross struts, reinforced by triangular plywood stiffeners in each bay and braced internally with piano wire. By unlacing the fabric half way along the rear fuselage to expose steel jointing plates, the fuselage could be taken apart quite easily to facilitate packing. Its maximum width was only 2 ft. but there was sufficient depth for the pilot to sit wholly inside with a somewhat restricted view through a number of celluloid windows. Entry was through a sheet aluminium trap-door in the roof and large circular holes were provided in each side through which the head could be thrust when flying in poor visibility. Fuel and oil tanks were situated inside the fuselage, remote from the engine to reduce risk of fire.

The mainplane, constructed in two halves round a built-up front spar, was mounted on the centre line of the fuselage and braced by wires to a stout kingpost under the fuselage and to a pylon of steel tubes on top. Lateral control was by wing warping.

The Type F monoplane was erected at Brooklands in April 1912 and Wilfred Parke made the first take-off on May 1, climbing the machine steeply

on half throttle. It was the first flight in the world by an aeroplane with a totally enclosed cockpit. Critics predicted that oil thrown back by the 35 h.p. Viale five cylinder radial engine would completely obscure the pilot's vision but this proved not to be the case. It was a carefully maintained engine well known to Parke, being that taken from the Type D school machine which he had flown from Brooklands to Abingdon in the previous January. First circuits were made on May 3 and test flying continued until May 17 when, during a flight over Chertsey, 1,000 ft. was reached for the first time. On May 25 it was decided to show the machine at Hendon but the engine failed soon after take-off and in the ensuing forced landing at Weybridge, Parke hit a fence and turned over. There was little damage and the Type F was dismantled by four men in 25 minutes for return to the workshops.

For some months the machine languished at Brooklands until taken out by R. H. Barnwell on September 13. After one or two straight hops, the front part of the skid was broken in landing and the aircraft turned over, suffering serious damage in the process. Barnwell was unhurt but it is evident that the Type F did not fly again.



SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Brooklands Aerodrome, Byfleet, Surrey

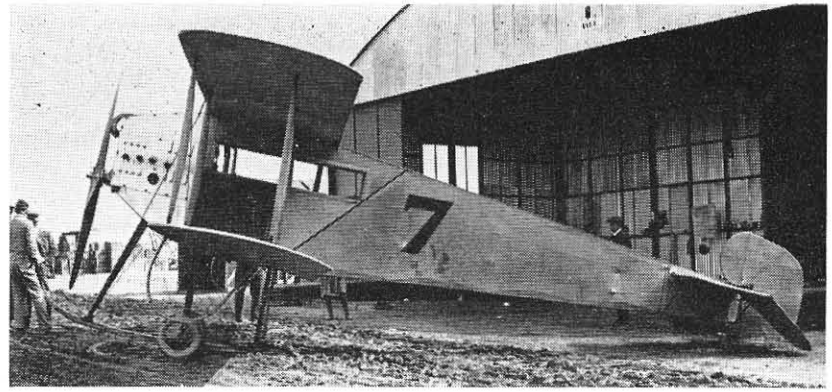
Power Plant: One 35 h.p. Viale

Dimensions: Span 28 ft. 0 in. Length 23 ft. 0 in.
Wing area 158 sq. ft.

Weights: Tare weight 550 lb. All-up weight 800 lb.

Performance: Maximum speed 65 m.p.h. Initial climb 300 ft./min.

Production: One aircraft only, first flown at Brooklands 1.5.12, damaged beyond repair at Brooklands 13.9.12. Engine preserved at the Science Museum, London, and the rudder by the Royal Aero Club.



The Avro Type G cabin biplane, 60 h.p. Green engine, at Larkhill in August 1912. (*Avro Photo.*)

Avro Type G

A. V. Roe's second cabin aeroplane was a two seat biplane designed specifically for the Military Aeroplane Competition of August 1912, and today historically important as the world's first cabin biplane. Very similar structurally to the Type F, the fuselage filled the whole mainplane gap and was again very narrow with a maximum beam of 2 ft. 3 in. tapering to only 15 in. at the front end. This was made possible by the use of a slim in-line engine mounted on steel bearers and enclosed in louvred cowlings with the main exhaust taken over the roof. As on the Type E prototype, cooling was by means of spiral tube radiators on each side of the cabin, entry to which was through triangular doors hinged to slanting struts in the sides of the fuselage. Mainplanes, undercarriage and tail unit were identical with those of the Avro 500. Once again there was no vertical fin and the steel shod rudder also acted as tail skid. Lateral control was by wing warping with a maximum warp at the tip of 18 in.

Two Type G biplanes were laid down. One with a 60 h.p. Green engine to be flown by Wilfred Parke with competition number 6 and a second, numbered 7, for R. L. Charteris of the All-British Engine Co. Ltd. with a 60 h.p. A.B.C. eight cylinder engine. Unfortunately this A.B.C. engine was not ready in time and as a matter of expediency No. 7 was completed with the Green engine in place of No. 6.

There was no time for test flying and the aeroplane was delivered in a crate direct to the competition ground at Larkhill on Salisbury Plain and there flown for the first time by Wilfred Parke. On August 7, 1912 he took off at the start of the 3 hours endurance test but after half an hour turbulent conditions compelled him to give up. Hurriedly landing down wind, he overturned and so damaged the machine that it had to be sent back to Manchester for repair. Exactly a week later on August 14, the machine returned, no doubt

incorporating many components of the unfortunate No. 6. During the resumed trials Parke demonstrated the machine's all-weather qualities by flying in a rainstorm for 37 minutes and for half an hour in a wind of 40 m.p.h.

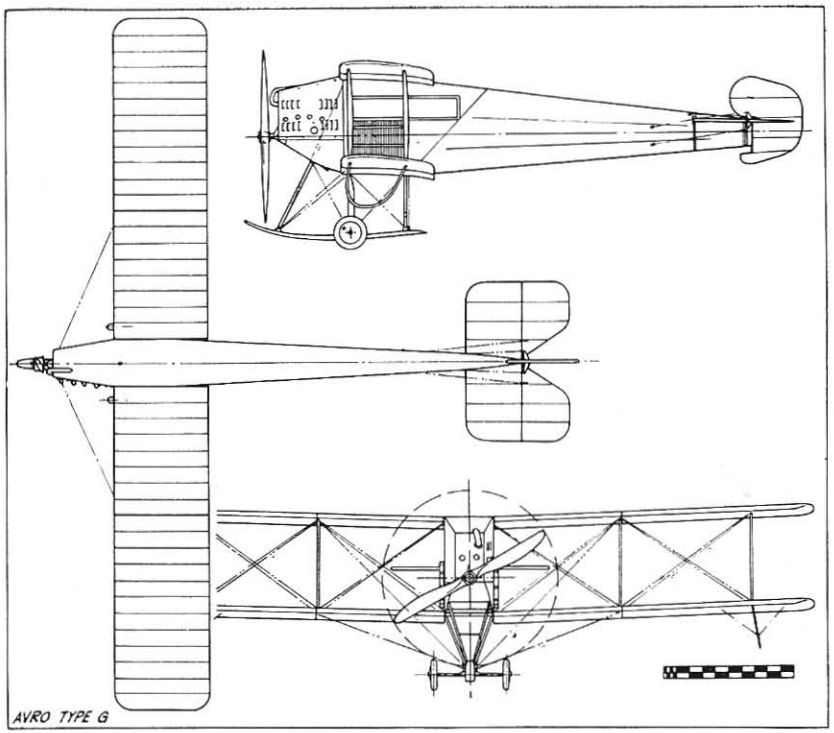
At 6.04 a.m. on Sunday August 25, 1912 Parke again started on the endurance test carrying Lt. Le Breton as passenger. Just after 9 a.m. he commenced a series of steep dives to relieve the monotony and in so doing spun off a turn, but Parke's cool head and analytical mind were equal to the situation and he soon discovered that if the stick were central, recovery was possible by applying full opposite rudder. He was the second pilot to survive a spin but the first to do so before competent observers. In the ensuing discussions he gave a lucid account of what had taken place and today 'Parke's Dive' is recognised as an important milestone in the development of flying techniques. Later in that eventful day H. V. Roe flew as passenger to Upavon and became the first person to type a letter in an aircraft in flight.

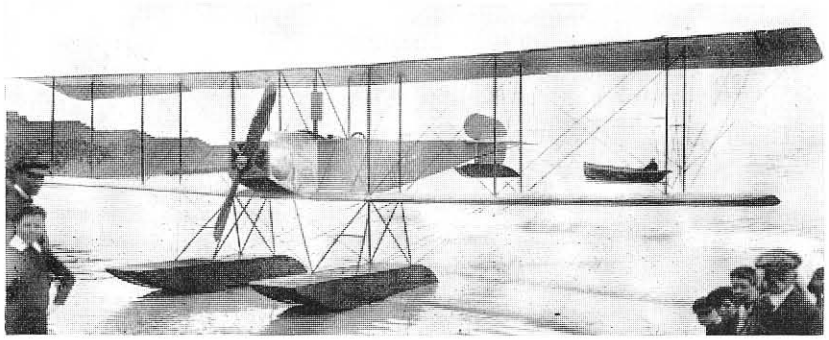
The Type G cabin biplane was an easy winner in the assembly test in a time of 14½ minutes compared with the 9 hours 29 minutes of the Farman biplane and although the accident left insufficient time for the compilation of all the required data, the Avro company was awarded £100 for attempting all the tests. The Type G failed to secure a major award because the initial rate of climb was poor (9 min. 30 sec. to reach 1,000 ft.).

F. P. Raynham flew the machine home to Shoreham on October 11 but it had been in the open for so long that both engine and rigging needed attention. He therefore took the machine to Brooklands for adjustments on October 21 in 45 minutes and next day made an attempt to win the British Empire Michelin endurance prize. A broken water connection ended the flight after 3½ hours but on October 24 he established a duration record for all-British aeroplanes with a time of 7 hours 31 minutes. Competing against Harry Hawker in the Sopwith Wright biplane, Raynham flew round Brooklands all day with the Green engine throttled right back to conserve fuel until forced to land through shortage of oil. His record stood for only an hour as Hawker went on to establish a new record of 8 hours 23 minutes and win the £500 prize. The Type G biplane was afterwards flown back to Shoreham where it was last heard of in February 1913 hangared with the Type D biplanes of the Avro School.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Company, Brownsfield Mills, Great Ancoats Street, Manchester; and Shoreham Aerodrome, Sussex
Power Plant:	One 60 h.p. Green
Dimensions:	Span 35 ft. 3 in. Length 28 ft. 6 in. Height 9 ft. 9 in. Wing area 335 sq. ft.
Weights:	Tare weight 1,191 lb. All-up weight 1,792 lb.
Performance:	Maximum speed 61.8 m.p.h. Initial climb 105 ft./min. Range 345 miles
Production:	One aircraft only, second machine not completed





The original Avro 503 seaplane moored at Shoreham in June 1913. (*Photo courtesy of the Royal Aeronautical Society.*)

Avro 501 and Avro 503 (Type H)

The choice of Shoreham as the Avro company's new flying ground when it moved from Brooklands in the autumn of 1912 was largely the result of Cdr. Schwann's successful waterborne experiments and Avro's awakening interest in seaplanes. It was an ideal site with Shoreham Harbour close at hand and it was from the adjacent River Adur that the Avro Type H seaplane made its first take-off. Construction of this machine followed tests on Windermere by H. Stanley-Adams in January 1913 with the Avro 501 which, apart from a considerable strut-braced top wing overhang, was similar to an enlarged float-equipped Avro 500. Built at Brownsfield Mills in November 1912 and powered by a 100 h.p. Gnome, the Avro 501 first flew as an amphibian with a sprung central float designed by O. T. Gnosspelius, 15 ft. long and 7 ft. wide from which projected three small wheels, two in the rear and one forward. With so narrow a float an aircraft with a wing span of 47 ft. 6 in. could be expected to heel over when steerage way was lost, and for this reason small wing tip floats were fitted and inclined to sit squarely in the water. This arrangement proved unsatisfactory and Gnosspelius replaced it with a twin float unit without wheels which made the aircraft sufficiently seaworthy to interest the Admiralty, to whom it was eventually delivered in the Isle of Grain. In the light of experience at Barrow, the airscrew leading edges were sheathed with brass to prevent damage from flying spray and the tail float was bolted directly to the old-style sprung rudder for steering on the water.

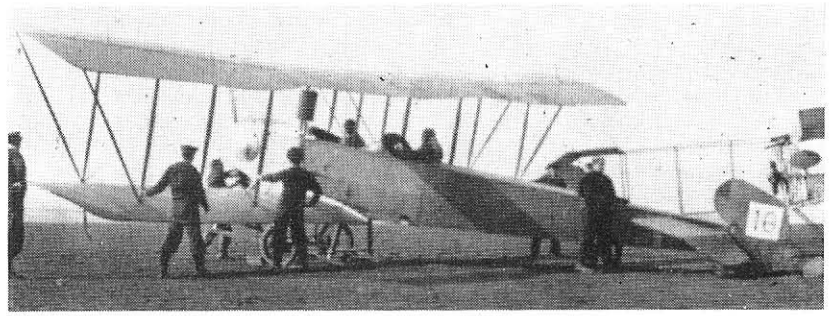
Also powered by a 100 h.p. Gnome, the Type H (later known as the Avro 503), was a slightly larger version of the Avro 501 but with less mainplane overhang and no inclined struts. Following standard Avro practice, the new seaplane was built with an eye to quick dismantling and was constructed round a 9 ft. centre section to which were bolted fuselage, undercarriage and outer wing panels. The upper mainplane, 3 ft. greater in span than the lower, was

fitted with large inversely tapered ailerons but none was fitted to the lower wing. Two-step, internally sprung floats, 14 ft. long and 2 ft. 6 in. wide, set at a track of 6 ft. 6 in., were covered with rubberised material and attached to the aircraft by 14 tubular steel struts bound with varnished fabric.

Such was his confidence in the Type H that F. P. Raynham made the first take-off from the Adur in sea mist on May 28, 1913 carrying passenger John Alcock, two hours' fuel and an anchor. The aircraft became airborne after a run of only 60 yards and cleared the adjacent railway bridge by 100 ft. Next day, again carrying the future conqueror of the Atlantic, Raynham made a first landing on the open sea outside Volk's seaplane hangar opposite Paston Place, Brighton. A float was damaged on take-off so a landing was made in Shoreham Harbour where the aircraft was hastily beached. After some local strengthening of the nose of each float the machine was out again on June 12 and two days later Raynham made an hour's demonstration flight over Brighton carrying Lt. J. W. Seddon R.N., Inspector of Naval Aircraft. Despite the weight and drag of the floats, the Type H climbed to 1,300 ft. in 5 minutes.

The Avro 503 was then flown by Capt. Schultz, a German naval officer who had made several visits to the works while it was under construction, and before the month was out the machine was purchased by the German Government, dismantled and packed for shipment. Flown by Lt. W. Langfeld it became on September 3, 1913 the first aircraft to cross the 40 miles of North Sea from Wilhelmshaven to the Island of Heligoland, a successful return trip to Cuxhaven being made on September 15. An Avro 503 seaplane was also ordered by the Peruvian Government but the outbreak of the First World War prevented delivery and it is believed to have been turned over to the British Admiralty.

At least three other 100 h.p. Gnome-powered Avro 503s were built—all to Admiralty order for use by the Royal Naval Air Service. The float undercarriage of the old Avro 501 having proved far too heavy, the Admiralty agreed to accept it as a landplane. A. V. Roe thereupon devised a two-wheel,



The Avro 501 in landplane form with naval serial *16* at Eastchurch 1913. (*Photo courtesy of C. H. Barnes.*)

twin skid undercarriage but the track was still too narrow to support the aircraft vertically at rest and stout wing tip skids were necessary. In landplane form, with large inversely tapered ailerons replacing the constant chord units, the Avro 501 was so quaint a structure that it soon earned the name "Rickety Ann". After delivery to Eastchurch it had to be lightened and several airscrews tried before F. P. Raynham could complete the acceptance tests. Bearing naval serial *16* it was flown to Shoreham on June 2, 1913 by Raynham with Lt. Seddon as passenger.

In the course of R.N.A.S. trials by F. P. Raynham at Eastchurch on August 28, 1913 a second landplane climbed to 3,000 ft. in 19 minutes with 36 gallons of petrol, 10 gallons of oil and 182 lb. of ballast. In the speed test 65·1 m.p.h. was reached and this aircraft, last of those ordered from A. V. Roe before the firm became a limited company, was followed by a float-equipped example which arrived at Sheerness in crates on September 8, 1913. On October 15 it was handed over to the R.N.A.S. in the Isle of Grain where it was joined eventually by an improved version built in the following December. One of these machines was damaged in a hangar fire at Eastchurch and sent to Brooklands for repair in July 1914.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Company (reconstituted as A. V. Roe, and Co. Ltd. 11.1.13), Brownsfield Mills, Great Ancoats Street, Manchester (moved to Clifton Street, Miles Platting, Manchester 4.13); and Shoreham Aerodrome, Sussex

Power Plant: One 100 h.p. Gnome

Dimensions, Weights and Performances:

	Avro 501 seaplane	Avro 503 seaplane
Span (upper)	47 ft. 6 in.	50 ft. 0 in.
Span (lower)	39 ft. 6 in.	47 ft. 0 in.
Length	33 ft. 0 in.	33 ft. 6 in.
Height	12 ft. 6 in.	12 ft. 9 in.
Wing area	478 sq. ft.	567 sq. ft.
Tare weight	1,740 lb.	—
All-up weight	2,700 lb.	2,200 lb.
Maximum speed	55 m.p.h.*	50 m.p.h.
Initial climb	—	225 ft./min.

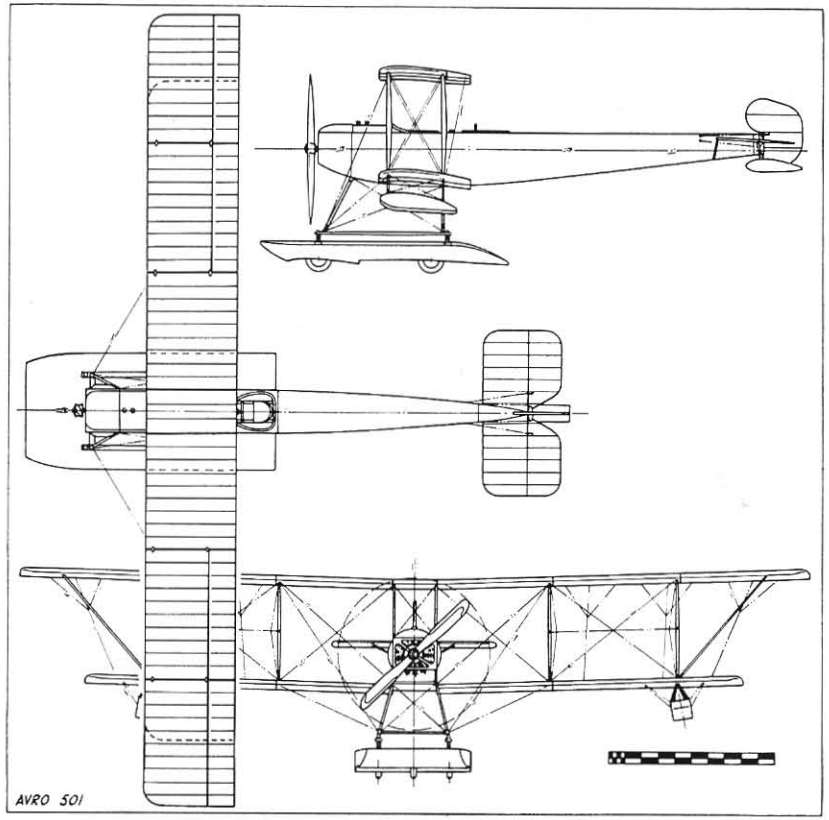
*Landplane 65 m.p.h.

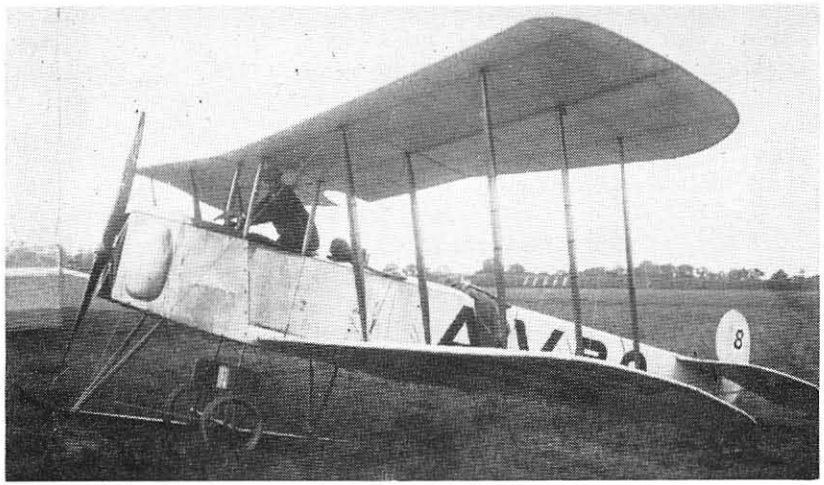
Production:

Avro 501 seaplane, first flown on Windermere 1.13, converted to landplane serial *16*, still airworthy in 1914

Avro 503 prototype first flown at Shoreham 28.5.13, to the German Navy 6.13 with serial *D12*

At least one other landplane to R.N.A.S. Eastchurch and two seaplanes to R.N.A.S. Isle of Grain





The prototype Avro 504 at Hendon, September 1913, in its original form with square cut engine cowling and warping 'ailerons'.

Avro 504 to Avro 504H

Design work on a successor to the Avro 500, begun at Brownsfield Mills in November 1912, was completed at the new Clifton Street works early the following year, Messrs. Chadwick and Taylor being responsible for the fuselage and undercarriage and H. E. Broadsmith the wings. Designated Avro 504, it was very lightly constructed with a rectangular section, wire braced, box-girder fuselage built from four ash longerons channelled for lightness and strengthened by flanges. Cross struts were of spruce. For maximum view the pilot sat in the rear, the passenger occupying the front cockpit, from the corners of which four ash struts supported the centre section. Equal span, two bay wings were rigged with 2 ft. stagger and braced by streamline section, hollow spruce interplane struts pin-jointed to the spars. Each wing panel consisted of five main ribs with spanwise stringers supporting a number of contour-forming strips of wood anchored to leading and trailing edges. Lateral control was by inversely tapered ailerons rigidly fixed at the inner end, the widened outer ends of which were warped by means of cables.

Although similar to that of the Avro 500, the undercarriage was a much improved and simplified unit. An ash skid was anchored to the fuselage by steel Vee struts as before, but the axle was no longer bolted to it and was no longer a laminated spring. Instead, a simple steel tube axle was used in conjunction with two main undercarriage legs having built-in rubber shock absorbers (8 ft. 8 in. of bungee cord wound round the two halves of the leg) in streamlined cases. The tail skid was attached to the bottom of a comma-type rudder.

In design, construction and performance the Avro 504 was considerably in advance of other 1913 types and benefited from the use of an improved wing section. Power was supplied by one of the new 80 h.p. Gnome rotaries (the actual power output of which is said to have been nearer 62 h.p.) installed in a square section cowling bulged on top and sides.

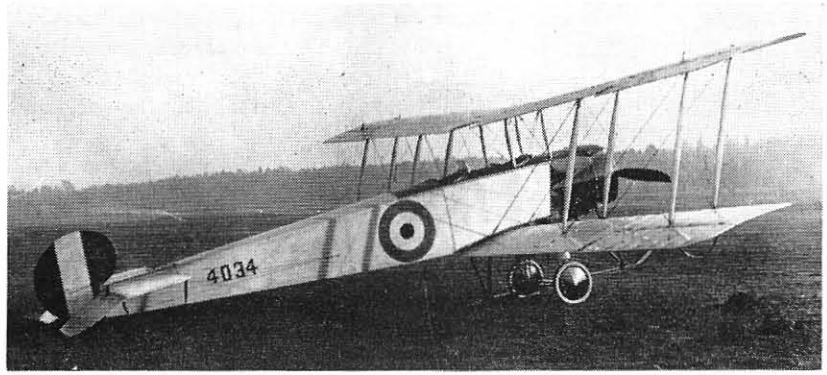
To give it the widest possible publicity the Avro 504 was entered for the 1913 Aerial Derby and consequently was built in considerable secrecy. Its arrival at Hendon on September 20, 1913, morning of the race, was therefore something of a sensation as it was obviously very fast and the impression of speed was heightened by its staggered mainplanes. When F. P. Raynham crossed the finishing line in fourth place at an average speed of 66·5 m.p.h., few realised that the Avro 504 was virtually untried, having been delivered at Brooklands only three days before (September 17), and flown for the first time on the following day.

After the Aerial Derby the Blackburn Aeroplane and Motor Co. Ltd. issued a challenge to its Lancashire rivals and on September 29 Raynham flew the Avro 504 from Brooklands to Leeds for a race against a new Blackburn monoplane flown by Harold Blackburn. The 100 mile race was held on October 2 over a course starting and finishing at Leeds and passing over York, Doncaster, Sheffield and Barnsley. With H. V. Roe as passenger, Raynham flew neck and neck with Blackburn until bad visibility forced him to land near Barnsley.

Although basically a sound aeroplane the 504 needed modification and went back to the Manchester works where the engine mounting was changed for an improved version carrying more streamlined cowlings. Aileron control was also lightened by replacing the warping arrangement with constant chord



The 504 prototype at Paignton, Devon, in April 1914 rebuilt as a seaplane with rounded cowlings and constant chord ailerons.



4034, a production Avro 504A. (*Photo courtesy of the Royal Aeronautical Society.*)

hinged ailerons with wires to complete the circuit in place of the original rods. The wing structure was strengthened by replacing the hollow pin-jointed interplane struts by solid ones fitted in metal sockets. Redelivered at Brooklands at the end of October, the 504 was flown a great deal by Raynham during the following month. He made a forced landing at Horley with a broken carburettor control during the Hendon–Brighton–Hendon race on November 8; flew from Brooklands to Farnborough and back on November 15; gained second place in the Shell Trophy Race at Hendon the same afternoon and broke the lap record at 73 m.p.h.; spent a week on day and night flying at Shoreham and flew to Farnborough for official tests on November 24. With a passenger and fuel for three hours the Avro 504 clocked 80·9 m.p.h. over the measured mile and climbed to 1,000 ft. in 1 min. 45 sec.

An outstanding performance put up by Raynham on February 4 was a climb to 15,000 ft. over Brooklands. This exceeded the existing British altitude record by almost 2,000 ft. but was not an officially observed record. During the descent Raynham shut off his engine, put the machine into a glide, and 25 minutes later was at 5,000 ft. over Hendon some 20 miles away. He then spiralled down to a landing, still without using his engine. Carrying R. J. MacGeagh Hurst in the front seat Raynham made an officially observed climb to a record height of 14,420 ft. over Brooklands on February 10.

Later in the season the machine was purchased by the *Daily Mail* and toured the country giving passenger flights piloted by F. P. Raynham and G. Lusted. A. V. Roe and Co. Ltd. built an interchangeable twin float undercarriage so that the machine could be flown off the sea at coast resorts. At the same time the original 80 h.p. Gnome was replaced by an 80 h.p. Gnome Monosoupape which was supposed to give more power but which in fact gave only trouble. First flights as a seaplane took place at Paignton in April 1914, after which it visited Falmouth, Southport and Ireland but when war was declared on August 4 the machine was at Shoreham where it was immediately commandeered. Two days later the career of this historic

aeroplane ended when the engine failed as Raynham took off to deliver it to the R.N.A.S. With no height in hand there was no alternative to putting the machine down on land where it was damaged beyond repair.

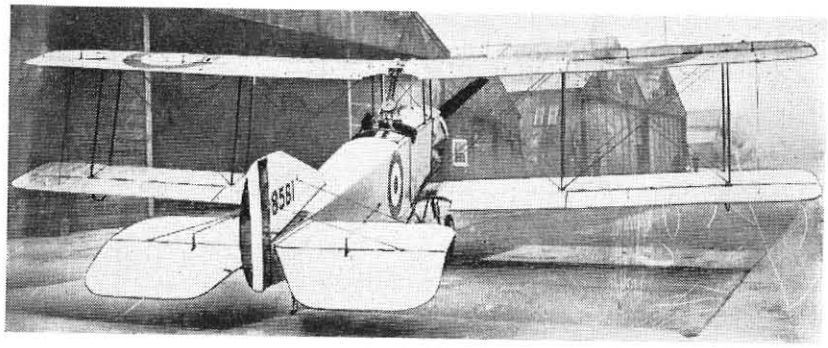
Series production of the Avro 504 began in the summer of 1913 when the War Office placed a contract for 12 machines. This brought about some restressing of the wings to comply with their strength requirements which included doubling the depth and width of the rear spar. Others were built for non-military and experimental purposes, one of which was exhibited at Belle Vue, Manchester on January 1–3, 1914 and another, delivered at Brooklands on February 16, was fitted with the first Armstrong Whitworth-built 100 h.p. A.B.C. engine. After endless engine runs Raynham made what was possibly its only flight with this engine early in April. Drawings were also



Production Avro 504B serial *1032*, with cut-away cockpit sides and tail skid pylon. (*Photo courtesy of the Royal Aeronautical Society.*)

prepared for the installation of a 65 h.p. Austro-Daimler engine but as far as is known this scheme was shelved. A third Avro 504 was exhibited with rubber-sprung float undercarriage at the Olympia Aero Show in March 1914 and another was delivered to Harold Blackburn at Southport in July. In common with thousands of Avro 504 variants built in later years, these aircraft were noticeably different from the prototype because the top longerons sloped downwards aft of the cockpits to make the fuselage symmetrical in side elevation.

Two Avro 504s, almost the last of the 12 War Office machines, were delivered at Brooklands on June 5, 1914 and it was in one of these on June 12 that F. P. Raynham succeeded in looping a 504 for the first time. They were delivered next day to Farnborough where *376* (probably the first machine of the batch) was tested to destruction during July. A few Avro 504s were among the aircraft of No. 5 Squadron R.F.C. when it left for France on August 13, one of which became the first British aeroplane brought down by the Germans



A R.N.A.S. anti-Zeppelin Avro 504C.

when Lts. V. Waterfall and C. G. G. Bayly were hit by infantry fire in Belgium on August 22. In mid-October, *383*, another Avro of the squadron was fitted with a Lewis gun by 2nd-Lt. L. A. Strange whose gunner, Capt. L. da C. Penn-Gaskell straffed a troop train at Perenchies and forced down an Albatros two seater near Neuve-Église a month later. Only a few Avro 504s saw front-line service and the greatest number in R.F.C. squadrons in France at any one time was thirteen.

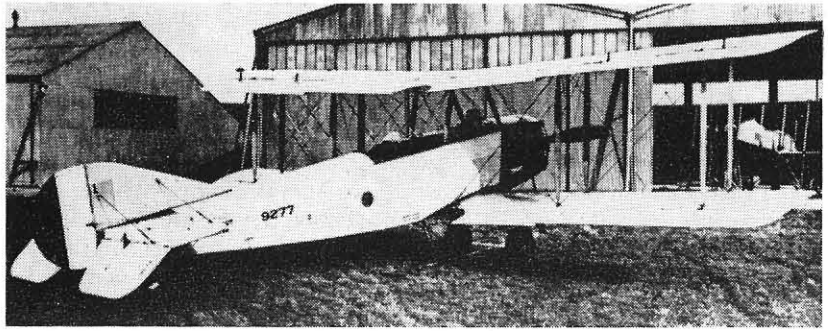
The Admiralty placed an order in the spring of 1914 for one Avro 504 and for six others a few months later. The first of these was delivered to the R.N.A.S. Eastchurch Squadron on November 27, 1914. Armed with four 16 lb. bombs and piloted by Flt. Sub-Lt. R. H. Collet, an attempt to bomb the Bruges submarine depot on December 14 was foiled by bad visibility and an attack was made on the Ostend–Bruges railway instead. Very few offensive sorties were made by the Avro 504, the most ambitious being the brilliant and historic raid on the Zeppelin sheds at Friedrichshafen. A special flight of four machines formed at Manchester in October 1914 by Sqn. Cdr. P. Shepherd, was equipped to carry four 20 lb. bombs per aircraft and shipped from Southampton to Le Havre. They arrived at Belfort by train on the night of November 13, 1914 and were hidden in a barn for fear of arousing the suspicions of local spies. It was not possible to flight test them and the first machine, *874*, took off untried at 9.30 a.m. on November 21 piloted by Sqn. Cdr. E. Featherstone Briggs. Flt. Cdr. J. T. Babington then left in *875* followed by Flt. Lt. S. V. Sippe with five minutes separation in *873*. Flt. Sub-Lt. R. P. Cannon's machine *179* (the first Avro 504 built for the R.N.A.S.) broke its tail skid and could not go. The raiders followed the Rhine at 5,000 ft., crossed Lake Constance at 10 ft. and put several bombs into the airship sheds from 1,200 ft. They narrowly missed destroying naval Zeppelin *L.7* but hit the gas plant which exploded with considerable violence. Briggs was shot down but the others made the 125 mile return trip in safety after four hours in the air. Flown by Flt. Lt. H. L. Rosher, Sippe's Avro *873* was one of five belonging to No. 1 Sqn. R.N.A.S. which twice bombed Ostend and

on March 24, 1915 destroyed two U-boats in an attack on the submarine depot near Antwerp. Together with *179* and *875*, it survived to return to England for overhaul and transfer to school work.

When the Avro 504 was relegated to training, a duty it was destined to fulfil with distinction for over 15 years, A. V. Roe and Co. Ltd. designed and supplied a self contained dual control unit comprising seats, control columns and rudder bars. Later in 1915 converted machines were joined by a number specifically built as trainers, total Avro 504 production amounting to 63 aircraft. As the war progressed, modification gave rise to a series of variants. The Avro 504A, built for the R.F.C., was a strengthened version with wide chord interplane struts and ailerons of reduced span. The lower wing roots were sometimes stripped of fabric to improve the downward view and *2905*, delivered on January 17, 1916, was used at Farnborough for fabric tests. At least *B3103* was fitted with an improved undercarriage having rear shock legs and front radius rods for use by the C.F.S. Communications Flight at Lopscombe Corner, Salisbury in 1918.

The Admiralty insisted on wing spars of greater cross section and was supplied with a drastically modified version known as the Avro 504B. It reverted to long span ailerons and was identified by a large, unbalanced rudder hinged to a considerable dorsal fin. The top longerons were recessed to provide curved cut-outs in the sides of the rear cockpit. A stout ash tail skid, sprung with rubber cord and hinged to a pylon under the rear fuselage, became standard fitment on this and all subsequent 504 variants. A few R.N.A.S. Avro 504Bs were used operationally at Dunkirk, including *9890* and *N5267* which had forward-firing guns and interrupter gear. A pioneer Zeppelin interception was also made by an Avro 504B from R.N.A.S. Westgate piloted by Flt. Sub-Lt. Mulock who made contact with *L.Z.38* in the early hours of May 17, 1915. The airship climbed too rapidly for him to use his armament of two hand grenades and two incendiary bombs but later the same night the Avro 504B *1009*, piloted by Flt. Cdr. A. W. Bigsworth, pursued *L.Z.39* towards Ostend with more success. He managed to gain sufficient height to drop four 20 lb. bombs on the airship's stern and caused slight damage by fire which led to a heavy landing at Evere, Brussels.

The majority of Avro 504Bs were naval trainers and late production models had the 80 h.p. Le Rhône, provision for Scarff ring and no cut-outs to the rear cockpit. At least one was used in early deck landing arrester gear experiments. In the coastal reconnaissance role the endurance was increased to $4\frac{1}{2}$ hours but this soon proved insufficient and 80 examples of a single seat version having 8 hours endurance were built. Powered by an 80 h.p. Gnome and known as the Avro 504C, it had a large cylindrical fuel tank in place of the front cockpit and a gap in the top centre section through which a Lewis gun could fire incendiary ammunition upward at an angle of 45 degrees. The R.F.C. equivalent, conceived in 1916 under the designation Avro 504D, retained the balanced comma-type rudder and short span ailerons, but had the recessed longerons and wing root modifications of the Avro 504C. Serial



9277, one of the ten Avro 504E biplanes. (*Imperial War Museum Photo Q.67065.*)

allocation suggests that six 504Ds were ordered but there is no evidence that they were actually built.

Modification on this scale led to a severe weight penalty and additional power had become a dire necessity. The next R.N.A.S. variant, the Avro 504E, was therefore fitted with the 100 h.p. Gnome Monosoupape. At the same time the rear cockpit was moved farther aft and the change of C.G. position caused by installing the main fuel tank between the cockpits was counteracted by reducing the stagger from 24 to 9 in. Centre section struts were then repositioned to converge towards the top in side elevation. The 504E also reverted to the straight top longerons of the prototype but was fitted with the fin, rudder and ailerons of the 504B. Ten were built, some of which were used at Chingford and Fairlop and one at Cranwell.

Designation Avro 504F was given to a single Avro 504C *8603* fitted at the suggestion of the Admiralty with a 75 h.p. Rolls-Royce Hawk six cylinder in-line engine. It was evidently an unsuccessful union as a contract for 30 Avro 504F aircraft was cancelled and replaced by one for the 80 h.p. Gnome version.

Uncertainty still shrouds the precise identity of the Avro 504G, described by Avro works manager R. J. Parrott in 1925 as an R.F.C. gunnery trainer, ten examples of which were built with 130 h.p. Clergets and equipped with synchronised front Vickers gun and rear Lewis. Designation Avro 504G was used also by the R.N.A.S. for the 80 h.p. Gnome-powered Avro 504B conversions having synchronised front Vickers guns and a Scarff ring on the rear cockpit.

Last of the early exploratory variants was the 504H, a strengthened 504C fitted under the supervision of Sqn. Cdr. E. H. Dunning in 1917 with catapult pick-up points and a special padded seat. Piloted by Flt. Cdr. R. E. Penny this machine later became one of the first aircraft successfully launched by catapult.

At this stage of the war orders for the several variants were far in excess of production capacity at Manchester and a number of sub-contractors were brought in as listed in the data section.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester
The Bleriot & Spad Aircraft Works, Addlestone, Surrey
The Brush Electrical Engineering Co. Ltd., Loughborough
The Eastbourne Aviation Co. Ltd., Eastbourne
The Humber Motor Co. Ltd., Coventry
Parnall and Sons, Mivart Street, Eastville, Bristol
The Regent Carriage Co. Ltd., Fulham, London
S. E. Saunders Ltd., East Cowes, Isle of Wight
The Sunbeam Motor Car Co. Ltd., Wolverhampton

Power Plants:

(Prototype)	80 h.p. Gnome
	80 h.p. Gnome Monosoupape
(Avro 504 and 504A)	80 h.p. Gnome
	80 h.p. Le Rhône
	100 h.p. A.B.C.
(Avro 504B)	80 h.p. Gnome
	80 h.p. Le Rhône
(Avro 504C and 504D)	80 h.p. Gnome
(Avro 504E)	100 h.p. Gnome Monosoupape
(Avro 504F)	75 h.p. Rolls-Royce Hawk
(Avro 504G and 504H)	80 h.p. Gnome

Dimensions: Span 36 ft. 0 in. Length 29 ft. 5 in.
Height 10 ft. 5 in. Wing area 330 sq. ft.

Weights and Performances:

	Prototype	Avro 504		Avro 504A Le Rhône
		landplane	seaplane	
Tare weight	—	924 lb.	1,070 lb.	1,050 lb.
All-up weight	1,550 lb.	1,574 lb.	1,719 lb.	1,700 lb.
Maximum speed	81 m.p.h.	82 m.p.h.	75 m.p.h.	86 m.p.h.
Climb to 3,500 ft.	7 min.*	—	—	7 min.**
Endurance	3 hours	—	—	4½ hours***

*With 80 h.p. Gnome Monosoupape. **With 80 h.p. Gnome 9 min. 30 sec.
***With Avro 504C and 504D 8 hours.

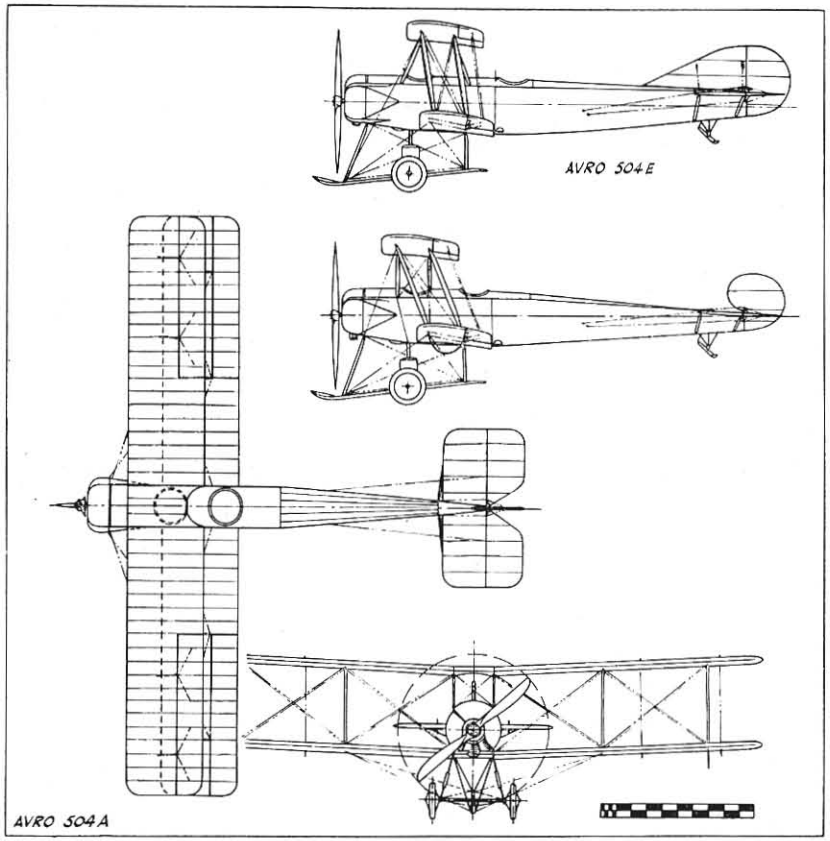
Avro 504 Production:

Quantity	For	Remarks
1	Avro	Prototype, first flown 18.9.13, crashed at Shoreham 6.8.14
At least 4	Avro	Exhibition, private and experimental aircraft
12	War Office	Constructor's numbers A.V.R.1 to A.V.R.12, serials included *376*, *383*, *398*, *568*, *637*, *683* and *715*
1	Admiralty	Serial *179*
44	War Office	First war order for the Army, serials *750* to *793*
6	Admiralty	Covering order for machines taken out of Army contract for Friedrichshafen raid, serials *873* to *878*

Avro 504A Production:

Serial range	Manufacturer	Serial range	Manufacturer
2890 to *2939*	A. V. Roe	**A9763* to *A9812*	Saunders
4020 to *4069*	A. V. Roe	**B901* to *B1000*	A. V. Roe
4737 to *4786*	A. V. Roe	*B1390* to *B1394*	Renumbered on transfer from R.N.A.S.
7446 to *7455*	A. V. Roe	*B1397* to *B1400*	
7716 to *7739*	A. V. Roe	**B3101* to *B3250*	A. V. Roe
7943 to *7992*	A. V. Roe	*B3251* to *B3300*	Humber
A412 to *A461*	Saunders	**B4201* to *B4350*	A. V. Roe
A462 to *A511*	Bleriot & Spad	*B4351* to *B4400*	Contract cancelled
A512 to *A561*	A. V. Roe	*B8581* to *B8780*	Parnall
A1970 to *A2019*	Bleriot & Spad	*B8781* to *B8830*	Contract cancelled
A2633 to *A2682*	A. V. Roe	*C551* to *C750*	Humber
A3355 to *A3404*	Saunders	***D1601* to *D1650*	Eastbourne
A5900 to *A5949*	A. V. Roe	***D6201* to *D6250*	Humber
A8501 to *A8600*	A. V. Roe	***D8251* to *D8300*	A. V. Roe

*Some completed as Avro 504J. **Some completed as Avro 504K.



Avro 504B Production:

Serial range	Manufacturer	Serial range	Manufacturer
1001 to *1050*	A. V. Roe	*N5800* to *N5829*	Parnall
9821 to *9830*	A. V. Roe	***N6010* to *N6029*	Parnall
9861 to *9890*	Parnall	*N6130* to *N6159*	Sunbeam
**N5250* to *N5279*	Sunbeam	*N6650* to *N6679*	
N5310 to *N5329*	Regent		

*Some completed as Avro 504J. ***N6015* to *N6029* transferred to the R.F.C.

Other variants:

Serial range	Type	Manufacturer	Serial range	Type	Manufacturer
794 to *799*	504D	A. V. Roe	**8547* to *8603*	504C	A. V. Roe
1467 to *1496*	504C	Brush	*9276* to *9285*	504E	A. V. Roe
3301 to *3320*	504C	Brush			

**8603* fitted with 75 h.p. Rolls-Royce Hawk as the single seat Avro 504F.

Service Use:

A complete record of machines held on charge by individual squadrons no longer exists, but specimen serial numbers are given where possible.

(*a*) In France: No. 1 Sqn. R.F.C., *752*, *758*, *769*, *773*, *2859*, *4223*; No. 5 Sqn. R.F.C., *383*, *568*, *637*, *715*, *750*, *755*, *782*, *783*, *4225*; No. 23 Sqn. R.F.C., *4741*; Nos. 1 and 3 Sqns. R.N.A.S.; the Belfort Zeppelin Flight (1914), *179*, *873–875*.

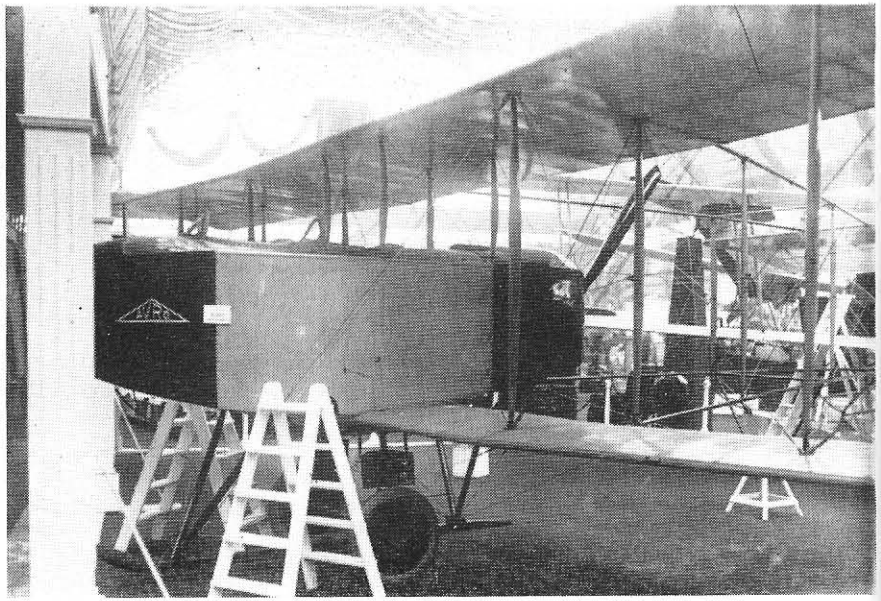
(*b*) Overseas: Aboukir, *A266*, *A545*, *A547*, *D5479*; No. 2 Wing, Imbros, *1040–1043*.

(*c*) Home Defence: Nos. 33, 51, 75, 76, 77 and 90 Sqns. R.F.C.

(*d*) R.N.A.S. Stations at Cranwell, *1028*, *1492–1494*, *2930*, *3302*, *3318*, *9278*, *9821*, *9822*, *9862–9864*, *9870*, *N5271*, *N6654*, *N6666*; Chingford, *876*, *1031–1034*, *9277*; Dover, *1034*; Frieston, *N6158*; Manston, *9880*; Port Victoria, *1046*; Redcar, *2929*, *2933*, *2934*, *8594*, *8600*, *9865–9867*, *9869*, *N5264*, *N5266*; Westgate; Great Yarmouth.

(*e*) Training: No. 31 Sqn., *A426*, *C4436*; No. 35 Sqn., *A8505*; Flying Instructors' Schools at Gosport, *A9799*, *A9810–A9812*, *B987*, *B3101–B3104*, *B3131*, *'55*, *'58*, *'59*, *'65*, *'67*, *'69*, *'72*, *'74*, *'96*, *B4222*, *'23*, *'42*, *'43*, *'45*, *'46*, *'49*, *'50*, *'63*, *'65*, *'66*, *C606*, *'08*, *'09*, *C4344*, *C4431–C4433*, *C4447–C4452*, *D41*, *D42*; Shoreham; Lilbourne; Redcar; Ayr; Curragh (Ireland).

(*f*) Working-up squadrons: Nos. 24, 40, 45, 65, 186, 188 and 190 Sqns. R.F.C.



The Avro 508 reconnaissance pusher at the Olympia Aero Show, London, in March 1914. (*'Flight' Photo.*)

Avro 508

The Avro 508 was a two seat reconnaissance biplane built at the Manchester works in December 1913 and delivered at Brooklands for erection and test a month later. Following contemporary practice it was a twin boom, three bay pusher biplane of fabric covered wooden construction having equal span mainplanes structurally similar to those of the Avro 504 prototype. A wide centre section carried the first pair of interplane struts at its extremities, the dihedral commencing at this point as on the Avro 503. Ailerons were used for lateral control and the machine was noteworthy as the first Avro type to have aileron cables located inside the wing leading edge and running over buried pulleys.

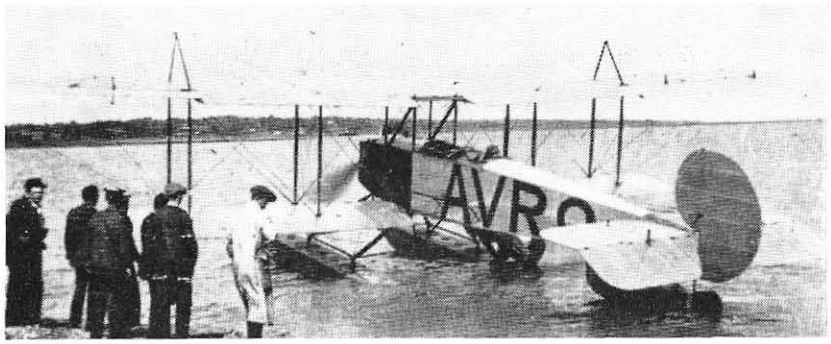
A capacious square-section nacelle, built up from four ash longerons and spruce cross struts, accommodated two crew in tandem. The observer/gunner sat in the nose for maximum field of vision with the pilot behind. Fuel and oil tanks were located behind the pilot's seat and just ahead of an 80 h.p. Gnome rotary engine mounted on steel tube bearers. The use of standard Avro cowlings and centre skid undercarriage heightened its likeness to a back-to-front Avro 504. Tail booms were of steel tubing braced by streamline section spruce struts, the rear extremities of which were built into the tailplane structure. For ease of dismantling, the booms were jointed just

ahead of the tailplane leading edge. The rudder was an elongated version of the famous comma type, somewhat like an artist's palette.

The Avro 508 was not adopted for the Royal Flying Corps and the single machine built made but two public appearances. The airframe was shown without covering at an exhibition at Belle Vue Gardens, Manchester on January 1–3, 1914 and the complete aircraft was shown on the Avro stand at the Olympia Aero Show, London on March 16–25, 1914.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Brooklands Aerodrome, Byfleet, Surrey
Power Plant:	One 80 h.p. Gnome
Dimensions:	Span 44 ft. 0 in. Length 26 ft. 9 in. Height 10 ft. 0 in. Wing area 468 sq. ft.
Weights:	Tare weight 1,000 lb. All-up weight 1,680 lb.
Performance:	Maximum speed 65 m.p.h. Endurance 4½ hours



The Avro 510 prototype at Calshot, July 1914.

Avro 510

The Avro 510 was a large two seat, two bay seaplane built for the 1914 Circuit of Britain Race. A larger version of the 504 rudder proclaimed the aircraft's Avro origins but it bore no other resemblance to any previous machine built by the firm. The upper mainplane overhung the lower by more than 12 ft. and the extension planes (which carried the ailerons), were braced by cables to steel tube kingposts. Power was derived from a 150 h.p. Sunbeam eight cylinder watercooled engine (later named the Nubian), fitted with nose radiator and stub exhausts.

The undercarriage consisted of four steel struts connected at their lower extremities to a tubular steel rectangle, the corners of which were bolted to the attachment points of each float. These were of entirely new design with a pronounced taper aft of the single step. The tail was supported on a large wooden float with water rudder.

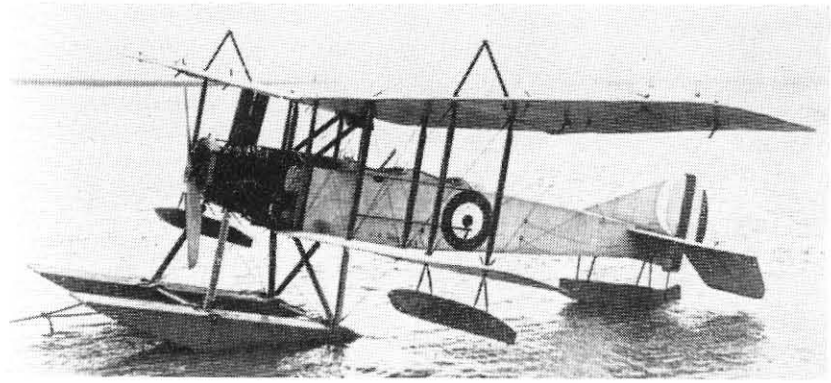
Built at Manchester in July 1914, the Avro 510 was despatched by rail to Calshot, starting point of the race. Following by road to supervise its erection, A. V. Roe put up for the night at Havant where the next morning he learned of England's declaration of war on Germany. The race was perforce cancelled but the Avro 510 was erected and flew well, the new float design being particularly successful. Much smoother landings were possible than with the old flat backed pontoon-type floats.

When the trials were complete, the machine was purchased by the Admiralty and much to A. V. Roe's surprise a cheque was handed over on the spot by Capt. (later Air Vice Marshal Sir Arthur) Longmore. The Admiralty also placed an order for five production Avro 510s but stipulated a taller undercarriage incorporating an extra inclined strut and using the well-tried, but entirely outmoded, flat backed floats. These were bolted direct to the struts without the complicated sub-frame of the original. To A. V. Roe's disappointment the modern floats of the prototype were also replaced.

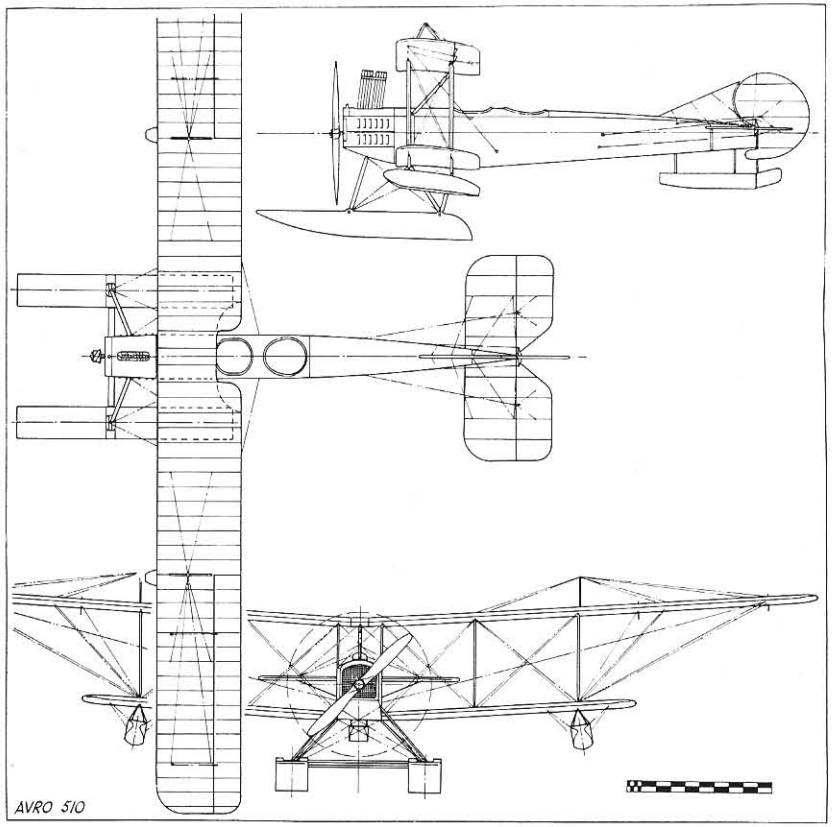
R.N.A.S. Avro 510s were fitted with a fixed fin having a curved trailing edge which fitted snugly round the leading edge of the rudder. All six were based at Calshot and all were powered by the 150 h.p. Sunbeam. Data was published for a version with the 160 h.p. Gnome rotary but there is no evidence that this motor was ever fitted to an Avro 510. The Service history of the type is obscure but it is known that *130* was in service at Calshot until September 1917, and that *131* remained there in June 1916 while the remaining Avro 510s went to the Supermarine Works at Woolston for modification.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester
Power Plants:	One 150 h.p. Sunbeam Nubian One 160 h.p. Gnome
Dimensions:	Span (upper) 63 ft. 0 in. (lower) 38 ft. 0 in. Length (Sunbeam) 38 ft. 0 in. (Gnome) 37 ft. 6 in. Wing area 564 sq. ft.
Weights:	(Sunbeam) Tare weight 2,080 lb. All-up weight 2,800 lb. (Gnome) Tare weight 2,005 lb. All-up weight 2,790 lb.
Performance:	Maximum speed 70 m.p.h. Climb to 1,000 ft. 4½ minutes. Endurance 4½ hours
Production:	Prototype sold to the Admiralty 1914 and numbered *881*; *130–134* built under Contract C.P.30654/14



One of the five production-type Avro 510s built for the R.N.A.S.





F. P. Raynham in the Avro 511 at Hendon on May 23, 1914. (*'Flight' Photo.*)

Avro 511

Three full sized aircraft shown on the Avro stand at the Olympia Aero Show, London, March 16–25, 1914 were a production Avro 504 seaplane, the Avro 508 pusher and the Avro 511 single seat, single bay biplane. This was designed specifically for fast scouting in the event of war and could be swiftly dismantled for road transport to the operational area. Heavily staggered, sparless mainplanes of cellular construction, designed and stressed by Avro's assistant designer H. E. Broadsmith, were given pronounced sweepback in an attempt to reduce the span and attain inherent stability. On this account the aircraft was promptly and unofficially dubbed "Arrowplane" or even "Arrowscout" by the sensational press but these names can find no place in a serious work of reference. Ailerons were fitted to all four wings and single wide chord interplane struts were used on each side. Landing flaps were incorporated in the inboard trailing edges of the lower mainplanes and pivoted diagonally about a stout steel tube which passed through the fuselage. This device, years ahead of its time, reduced touchdown speed to 35 m.p.h.

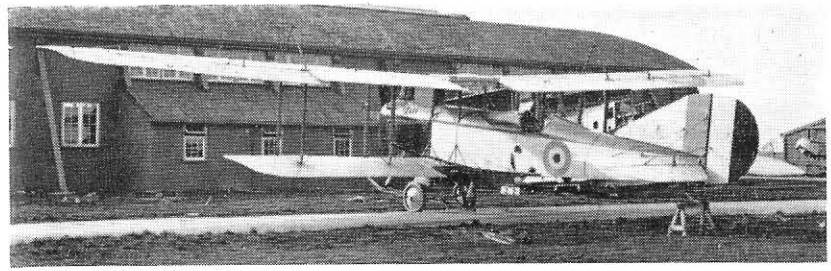
The Avro 511 was otherwise typically Avro with standard centre-skid undercarriage and comma-type rudder. The nose was of good streamline shape with a close fitting cowling round the 80 h.p. Gnome Monosoupape rotary engine. The cowling was later modified as it prevented adequate cooling. Estimated maximum speed was 95–100 m.p.h. and the machine was to have been piloted by F. P. Raynham in the Aerial Derby Race round London on May 23, 1914 (racing No. 14). Storms on the eve of the race caused deterioration in the weather which led to a postponement until June 6 but Raynham managed to make one or two demonstration runs for the benefit of the few hardy spectators. When returning home on the following day he made a safe landing after the engine failed within gliding distance of Brooklands. It had not

proved as fast as had been hoped but was nevertheless entered (racing No. 20) in the postponed Aerial Derby.

In preparation for this event the Avro 511 was fitted with alternative mainplanes without sweepback which Broadsmith had designed in case trouble was encountered with the swept wings. The rebuilt machine, designated Avro 514, was also equipped with a light weight, unsprung, Vee-type racing undercarriage without the familiar skid, but while taxying out at Brooklands to take off for Hendon on the eve of the race, an eye bolt sheared. The undercarriage collapsed, breaking the airscrew and bending the engine crankshaft as well as damaging wings and fuselage. After reconstruction at Manchester the Avro 514 was successfully flown from Southport Sands by F. P. Raynham in July 1914 but further development was ended by the outbreak of war.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Brooklands Aerodrome, Byfleet, Surrey
Power Plant:	One 80 h.p. Gnome Monosoupape
Dimensions:	Span 26 ft. 0 in. Length 22 ft. 4 in. Height 9 ft. 4 in. Wing area 235 sq. ft.
Weights:	Tare weight 675 lb. All-up weight 1,165 lb.
Performance:	Maximum speed 95–100 m.p.h.



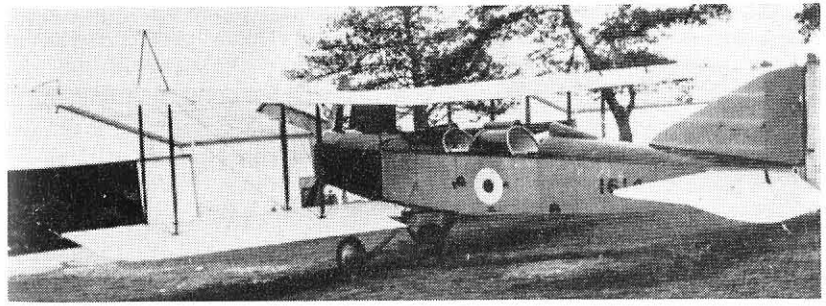
8441, second of the two R.N.A.S. Avro 519 single seat biplanes. (*Photo courtesy of the Royal Aeronautical Society.*)

Avro 519

Built for the Admiralty early in 1916, the Avro 519 single seat biplane bore a distinct resemblance to the Avro 510 seaplane of two years previously. Few technical details of the Avro 519 survive but it appears to have been fitted with the same wing structure as the 510, redesigned for folding and rigged with decreased gap. An enlarged version of the standard central skid undercarriage replaced the floats and the neat nose radiator was abandoned in favour of an ugly, high drag unit above and behind the engine which blocked the pilot's forward view. A large fin and rudder of the type used on the Avro 504B was also fitted.

The exact purpose of the aircraft is not known but pilot-comfort was evidently of some importance for the flat top of the Avro 510 fuselage gave place to a deep and generous decking. An elongated secondary structure on top of this formed a streamlined headrest.

Four prototypes were built, comprising two Avro 519s for the R.N.A.S. and two Avro 519A two seaters for the R.F.C. The latter were fitted with a stout Vee strut undercarriage with no skid, and photographs taken by test pilot Capt. F. T. Courtney suggest that all four were delivered to Farnborough for tests during or before May 1916. It is said that neither the



1614, first of the two R.F.C. Avro 519A two seaters.

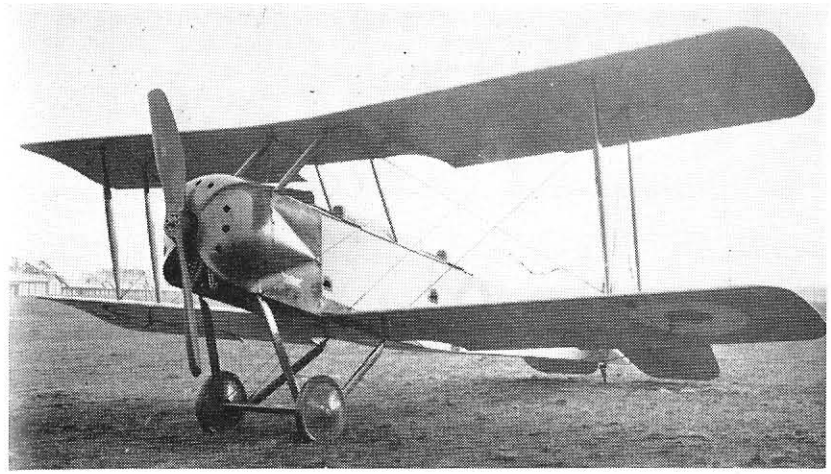
R.N.A.S. nor the R.F.C. considered them strong enough for the powerful 150 h.p. engine, and apart from the fact that they were dubbed "The Big Avros" and that their rate of climb was poor, no hint of their career or ultimate fate remains.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester

Power Plant: One 150 h.p. Sunbeam Nubian

Production: (For R.N.A.S.) *8440* and *8441*
(For R.F.C.) *1614* and *1615*



The unmarked prototype Avro 521. (*Crown Copyright Reserved.*)

Avro 521

Designed late in 1915, the Avro 521 two seat fighter-trainer was a hybrid embodying the features of several Avro 504 variants. In side elevation the straight top longerons proclaimed it a derivative of the 504 prototype, yet the short span ailerons and the rudder/tail skid assembly were pure 504A, the cockpit positioning and centre section struts were 504E, the Vee strut undercarriage was contributed by the 504G and the streamlined headrest was copied from the Avro 519. Standard Avro 504 mainplanes were shortened to a span of approximately 27 ft. 6 in., cut away at all four wing roots to improve upward and downward vision and rigged with only a single set of interplane struts on each side. The engine was a 110 h.p. Clerget rotary in characteristic Avro cowlings.

The initial order was for one machine, test flown at Trafford Park, Manchester by F. P. Raynham with H. E. Broadsmith standing up in the rear cockpit and brandishing a dummy machine gun to enable the effect of the extra drag to be assessed. Raynham found the Avro 521 longitudinally unstable and unpleasant to fly; nevertheless it was delivered to Farnborough in February 1916 and 25 production machines were ordered for the R.F.C.

Proposals were also made for interchangeable wings to suit different roles but it is not known if any aircraft were actually modified. Designation Avro 521A was allotted to a version with mainplanes of 46 ft. span, while with standard Avro 504 mainplanes of 36 ft. span it was to have been known as the Avro 521B. It is doubtful if all were completed and there is no record of any

production Avro 521 having been delivered. This strengthens the belief that the Avro 521 in which Capt. Garnett crashed and was killed at Gosport in 1917 must have been the prototype.

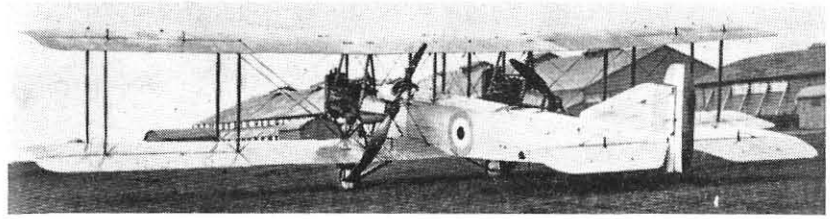
SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester

Power Plant: One 110 h.p. Clerget

Production: One unmarked prototype Works Order number believed 1811; and twenty-five production aircraft *7520* to *7544*, believed not all built

Service Use: At the Advanced Training School, Gosport, Hants.



The Avro 523 Pike showing the pusher airscrew installation.

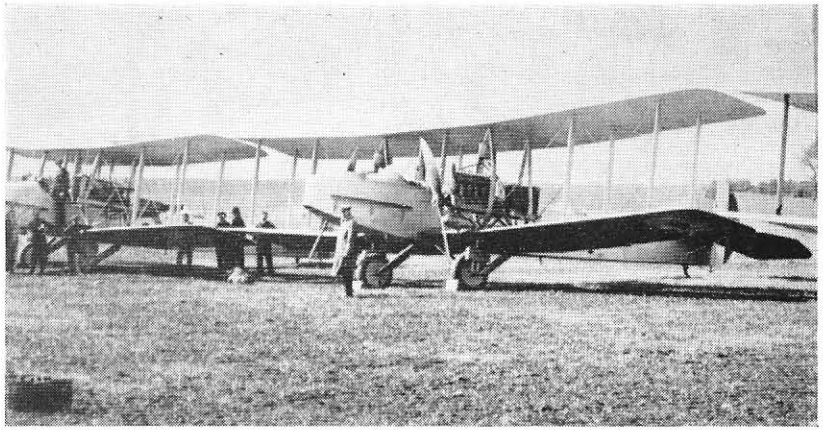
Avro 523 Pike

In 1916 A. V. Roe decided to move the Avro factory from Manchester to a waterside site convenient for the development of naval aircraft, and bought the stretch of Hampshire grassland which is now Hamble Aerodrome, together with a mile of foreshore on the adjacent Southampton Water. Manchester architect Harry Fairhurst designed the new Avro Hamble Works and a garden city of 350 houses for employees, but after the hangars and only 24 houses had been built, wartime shortage of building materials halted the scheme. Very reluctantly the company was compelled to keep its main works in Manchester and to use Hamble only for erection and as an experimental establishment.

It was to Hamble therefore that their first twin engined machine and the first to receive a type name, the Avro 523 Pike, was sent for erection and test in May 1916. Designed by Roy Chadwick to R.A.F. Types IV, VI and VII as a long distance photo-reconnaissance fighter or short range day or night bomber, it was powered by two opposite handed 160 h.p. Sunbeam engines driving pusher airscrews. A fine example of advanced thinking, the Pike was a large three-bay biplane equipped with horizontal-tier bomb-stowage (designed personally by A. V. Roe) and carrying the pilot just ahead of the mainplanes. Gunners' cockpits fore and aft were armed with Lewis guns on rotatable ring mountings. The divided undercarriage was sprung with larger editions of the famous Avro shock absorbers, and a large comma-type rudder was hinged to a fixed fin of low aspect ratio.

Although performance on a mere 320 h.p. was said to be very good, the Pike appeared too late. Production contracts had already been awarded to Short Bros. for a standard R.N.A.S. bomber, and the R.F.C. was interested solely in the much larger Handley Page heavy bombers then under construction.

The Pike prototype was sent to the R.N.A.S. experimental establishment on the Isle of Grain for test before Admiralty officials but during one test flight the Pike was flown with the C.G. position too far aft and was so tail heavy that F. P. Raynham dared not throttle back to attempt a landing. The situation was



The Avro 523A with two 150 h.p. Green engines and tractor airscrews, at Hamble 1916 with the Pike. (*Avro Photo.*)

saved through the gallantry of R. H. Dobson (later Sir Roy Dobson), who climbed out of the rear cockpit and along the top of the fuselage to transfer his weight to the bow gunner's position. The danger of stalling was averted and a successful landing made.

A second machine, the Avro 523A, tested at Hamble in August 1916, differed from the earlier machine only in the engine installation. It was fitted with two 150 h.p. Green engines mounted on revised strutting and driving tractor airscrews. Whereas the original Pike employed nose radiators on each nacelle, the Green engines of the 523A were cooled by rear mounted radiators. At the completion of official tests both machines were returned to the manufacturers to enjoy extensive experimental careers and were still in commission at Hamble in 1918. Plans to produce Avro 523B and 523C variants with higher powered Sunbeam and Rolls-Royce engines were shelved, but the Admiralty ordered an improved version which appeared in 1917 as the Avro 529.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.

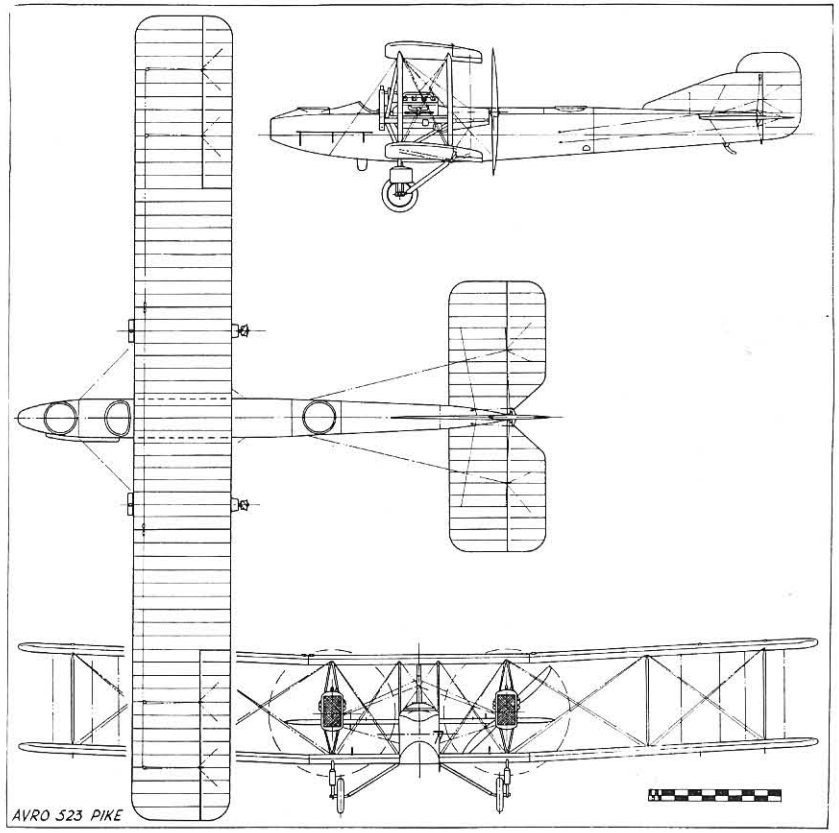
Power Plants: (Avro 523) Two 160 h.p. Sunbeam
(Avro 523A) Two 150 h.p. Green

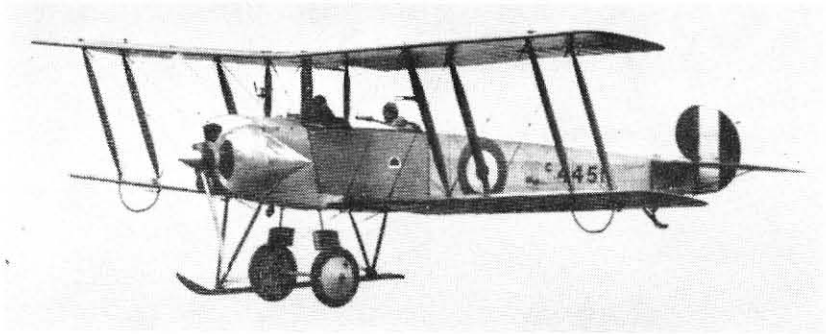
Dimensions: Span 60 ft. 0 in. Length 39 ft. 1 in.
Height 11 ft. 8 in. Wing area 815 sq. ft.

Weights: (Avro 523) Tare weight 4,000 lb. All-up weight 6,064 lb.

Performance: (Avro 523) Maximum speed 97 m.p.h.
Climb to 5,000 ft. 9 min. 30 sec.
Endurance 7 hours

Production: (Avro 523) One aircraft only, Works Order number believed 2230
(Avro 523A) One aircraft only, Works Order number believed 2231





Avro 504J *C4451* on which H.R.H. Prince Albert learned to fly, showing the characteristic lobed cowling. (*Imperial War Museum Photo Q.67100.*)

Avro 504J and Avro 504K

In the autumn of 1916 a more powerful version of the Avro 504A with the 100 h.p. Gnome Monosoupape was produced for the R.F.C. This variant, designated 504J and known in the R.F.C. as the "Mono Avro", was externally identical with the earlier type and large numbers ordered as 504As were completed as 504Js.

Among the first recipients of the Avro 504J was the School of Special Flying founded at Gosport in July 1917 by Maj. R. R. Smith-Barry. Here (and later at similar schools at Shoreham, Lilbourne, Redcar, Ayr and Curragh) instructors were introduced to Smith-Barry's revolutionary flying training technique, a system based on demonstration and explanation by an instructor who was in verbal communication with the pupil. The 'Gosport' speaking tubes specially designed for this purpose were still to be found in club aircraft half a century later. The Avro 504J was fully aerobatic and made an ideal training aircraft because its light and powerful controls quickly showed up faults in a pupil's flying. It is now historically important as the aeroplane which made possible a system of training which, in modified form, became part of the R.A.F.'s Flying Training School syllabus for more than 40 years. As the standard R.F.C. trainer, the Avro 504J was ordered in such quantity that contracts were placed with additional sub-contractors. Components for Avro-built machines were constructed in Manchester for erection at the company's new aerodrome at Hamble.

In his memoirs C. A. Nepean Bishop recalls that the Gosport School Avro 504J *C4448* was the personal machine of Capt. Williams whose favourite trick was to land between the hangars, touch down on the tarmac, swing completely round and finish the landing run inside 'C' Flight hangar. Among other Gosport instructors were Maj. E. L. Foote who was to become well known as airline, test and sporting pilot in the years immediately after the War, and Capt. Duncan Davis, manager of Avro's South Coast joyriding

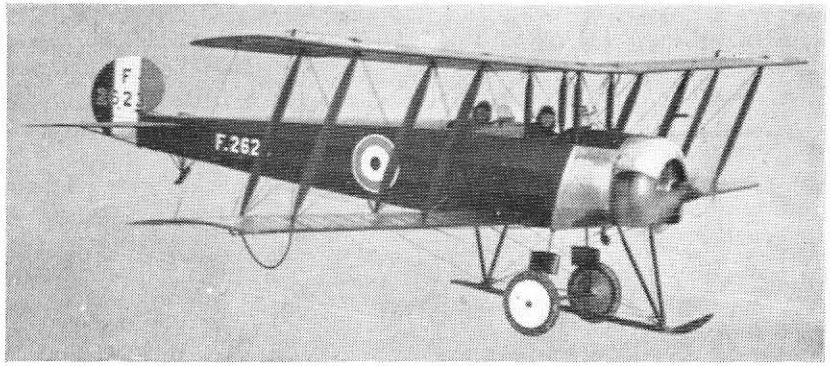
aircraft in 1919–20 and C.F.I. of the Brooklands School of Flying in the 1930s. A distinguished pupil was H.R.H. Prince Albert (later King George VI) who learned to fly on *C4451*. In 1918 a team of instructors took four Mono Avros across the Channel to demonstrate the Gosport system to the French.

By the end of 1917 the 100 h.p. Gnome Monosoupape was outmoded as a front line power plant and British production of this engine was allowed to tail off. To prevent interruption of Avro 504J production through engine shortage, all surplus rotaries, including 80 h.p. and 110 h.p. Le Rhônes as well as 130 h.p. Clergets, were collected from English and French aerodromes. There was no difficulty in fitting the 80 h.p. Le Rhône and a number of 504Js were thus powered, but it was necessary to modify the front fuselage before larger engines could be installed. Following the trial installation of a 130 h.p. Clerget in *B3157* for Smith-Barry at Gosport at the end of 1917, the Technical Dept. of the Air Board asked A. V. Roe and Co. Ltd. to produce adaptors and a new type of universal engine mounting. In the older machines this was of the two bearer type, the front bearer being in the form of a ball race supported on four tubular arms forming extensions to the fuselage longerons. This 'spider' was now replaced by an overhung mounting designed by H. E. Broadsmith which consisted of two bearer plates which would accept any suitable engine and allow the use of a smooth open fronted cowling. Irrespective of the type of engine fitted, aircraft built with this mounting were known as the Avro 504K, even though many had been ordered as 504Js or even 504As as shown in the table on page 64. The original 'Clerget Avro' *B3157* joined 'F' Flight, School of Special Flying, and crashed at Gosport on March 2, 1918.

With standardisation accomplished the way was clear for greatly increased production and the Avro company was authorised to plan the construction of



Avro 504J *B3103* of the C.F.S. Communication Flight at Lopscombe Corner, Salisbury, in 1918 with modified undercarriage. (*Photo courtesy of C. H. Barnes.*)



Avro 504K *F2623* during a postwar instructional flight over Salisbury Plain.

100 machines a week, plus spares. They were also required to produce 20 sets of knock down parts per week for assembly at the Eastern Aircraft Factory at Aboukir, Egypt and by the Armistice production had reached 80 Avro 504Ks a week, including 20 sets of components for Aboukir.

As a result of demonstration flights over Washington by Avro 504J *C4312* imported by the British Mission under Col. Lee in the winter of 1917–18, fifty-two Le Rhône engined 504Ks were purchased by the Americans in July 1918. These were used by the A.E.F. for advanced training at No. 3 Instruction Centre, Issoudun, France, and after the War survivors were shipped to the U.S.A., where one or two still exist.

Major modification of the Avro 504J was confined to the fitting of short span, single bay wings and curved fin to *B4264* at Gosport in January 1918. Standard 36 ft. mainplanes were eventually replaced, rigged experimentally with the gap reduced from 5 ft. 6 in. to 5 ft. $1\frac{1}{4}$ in. In March 1918 the same set of short span wings was fitted temporarily to *B3155*, a two seater with shortened fuselage and armed with a Lewis gun. In the following May it flew as a single seater with the fuel tank in the front cockpit, and this led logically to the first of a number of 110 h.p. Le Rhône engined single seat 504Ks for high altitude work with Home Defence Squadrons in the north of England. These had the gravity tank repositioned to port to make way for a Lewis gun on the top centre section, and with front cockpit faired in could reach 18,000 ft. Some were fitted later with a low drag Vee-type undercarriage similar to that of the Avro 521. Two so modified were flown at Gosport—*C605* with 130 h.p. Clerget on June 15, 1918 and *C604* with Le Rhône on February 3, 1919.

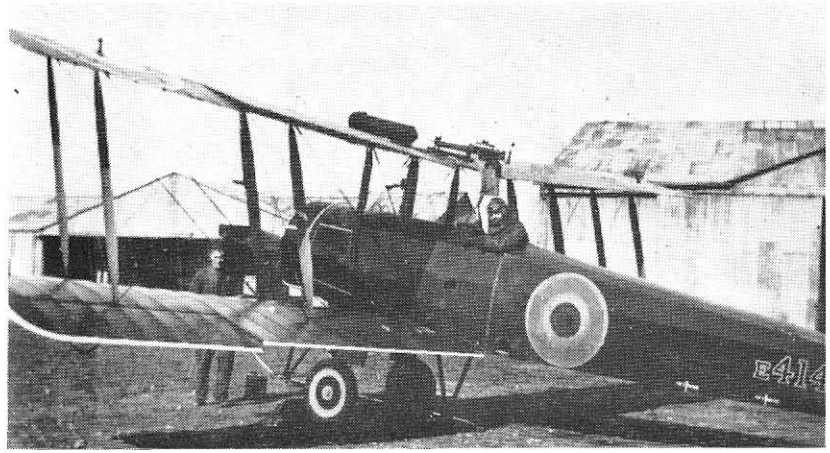
Total wartime production of Avro 504s of all marks exceeded that of any other type of British aeroplane but the oft quoted figure of 8,340 aircraft (3,696 by A. V. Roe and 4,644 by sub-contractors) is obviously in excess of the actual total. Nine were delivered to the Expeditionary Force in France in 1914; 4,771 to training units; 274 to Home Defence Units; 392 to the Middle East Brigade and 52 to the Americans. When the R.F.C. and R.N.A.S. came

under unified command on April 1, 1918, Avro 504Js and Ks were in use with almost every Service unit in Britain so that on October 31, 1918 there were 2,999 on R.A.F. charge (including 2,267 at flying schools and 226 on Home Defence). One hundred and eleven were in Egypt and Palestine, where some were pressed into emergency air mail service during the Egyptian rising of March–April 1919.

In 1919 the Sunbeam Motor Co. Ltd., sub-contractor for the Avro 504B, J and K, fitted one of its 100 h.p. watercooled Dyak airship engines into a 504K airframe. With brass nose radiator and attendant plumbing it was a heavy power plant which substantially reduced payload. Conversions were consequently few but two were supplied to Norway in 1920 and several were built for civil use with the Dyak engine in Australia in 1922.

The Royal Aircraft Establishment found the 504K a most useful test vehicle in the years immediately after the war, and each of Farnborough's resident machines was used for a wide variety of experimental flying. One important phase was flight testing a number of wings designed by Boulton and Paul, Humber, Vickers and the Steel Wing Company with metal spars and/or ribs. The metal wing programme was initiated partly through timber shortage but chiefly because seemingly identical wooden spars varied considerably in strength and weight. Minor experimental devices flown on the 504Ks ranged from a Leitner-Watts metal airscrew to a windmill-driven clear vision rotating windscreen.

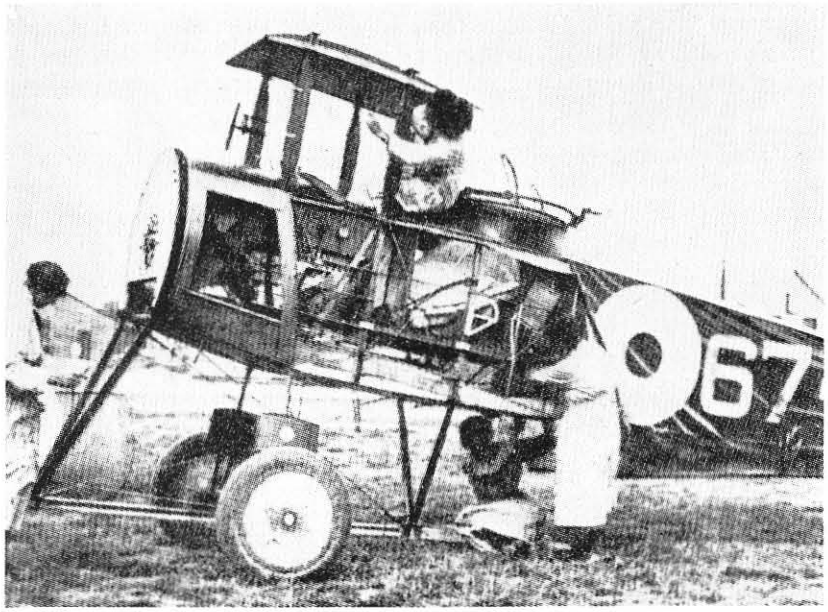
A postwar gunnery trainer version of the Avro 504K (130 h.p. Clerget) was designated Avro 540 but differed from standard only in the region of the rear cockpit which was strengthened and built up to take a Scarff mounting for a rear gunner. There was no new production, the few that existed being converted 504Ks.



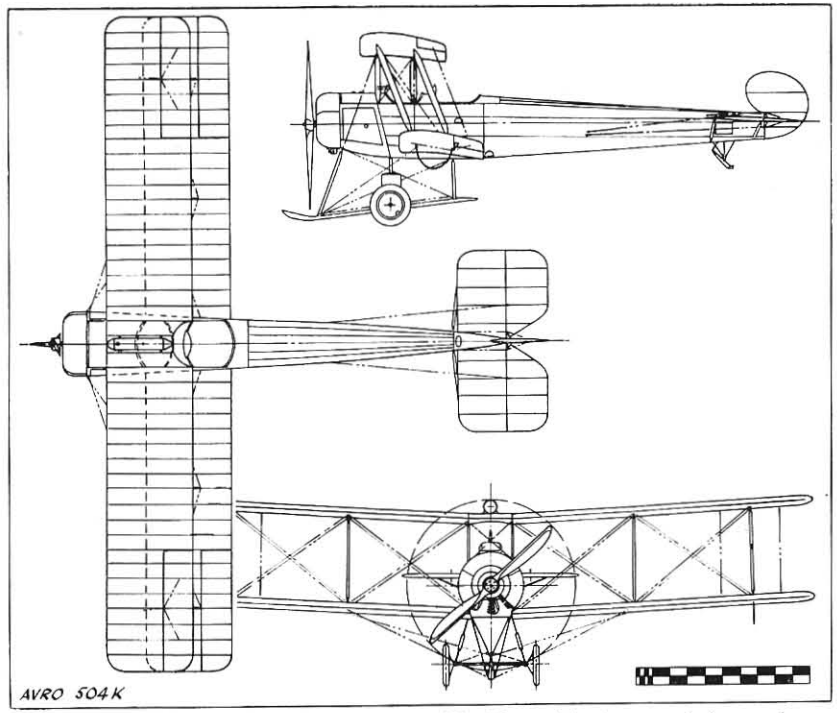
A high altitude Home Defence Avro 504K single seater with Lewis gun on the top centre section.
(Imperial War Museum Photo Q.67264.)

Of greater importance was the 504K's contribution to low speed flying research in the course of which *H2402* was fitted with a Vee-type undercarriage, water ballast tanks near the C.G. and in the tail, as well as an immense fin and unbalanced rudder. Eleven gallons of water could be pumped into the rear tank in the air to enable the aircraft to fly at very large angles of incidence (up to 35 degrees) with the object of exploring controllability in stalled flight and so reduce the risk of hitting the ground in a nose-down attitude as described in R. & M. 991. In the event, *H2402* experienced almost uncontrollable longitudinal oscillations and a second machine, *F8940*, with similar undercarriage, fin and rudder, was flown with variable incidence tailplane and lead weights up to 80 lb. over the tail skid. Large range differential ailerons allowing upward angles in excess of 90 degrees and interconnected with leading edge slots, were actuated by a wheel mounted on the control column. Research also embraced balanced ailerons mounted at mid-gap and concluded with flight tests by *E3269* equipped with Handley Page slots interconnected with Frise-type balanced ailerons. This aircraft was demonstrated sensationally by F/Lt. P. W. S. Bulman at Farnborough on April 15, 1925. A list of the main experimental machines appears in the data section.

The 504Js were declared obsolete in September 1921 but the 504K remained in service as the standard R.A.F. trainer with the C.F.S. and Nos. 1, 2, 3, 4 and 5 Flying Training Schools until the late 1920s. It also served with No. 24 (Communications) Squadron; with Nos. 600, 601, 602 and 603



The Avro 540, a postwar gunnery trainer version of the Avro 504K.



Auxiliary Air Force Squadrons; and with Fleet Air Arm training units at Netheravon and Leuchars. It took part in Hendon R.A.F. Displays, commencing in 1920 when F/O Quinland cavorted 'L'Avro Comique' *B3292* with extra large four speed and reverse gear box, be-cobwebbed undercarriage, vacuum cleaner, anchor, kettle, flue pipe, jazz painted interplane struts and four dummy heads! The Display of July 3, 1921 included a standard Avro race won for Kenley by F/O P. Murgatroyd who won again in the following year while representing Cranwell. Crazy flying by F/Lt. Jack Noakes in 1921 and F/Lt. W. H. Longton in 1922 brought congratulations from King George V. The Avro 504K made its final appearance in a star role in 1923 as the 'Orva Mayfly', which paraded in front of the crowd with 'A.B.C. Lion' engine, wireless clothes line, kettle, chimney, six inch gun and carrot accelerator!

The last Avro 504Ks, built by A. V. Roe to Contract 707157/26, appeared in two batches. The first 40, delivery of which was completed on November 11, 1926, were followed by 10 delivered by January 17, 1927.

In 1963 several Avro 504Ks survived in the U.K. in military markings. *D7560*, fitted with the wings of *E3104*, property of the Science Museum, London, was on permanent exhibition until stored in 1939. *H2311*, flown down from Scotland under another identity by F/Lt. Birch to join the Nash Collection at Brooklands in 1938, was overhauled by A. V. Roe and Co. Ltd. for the Royal Aeronautical Society in 1950 and flown at the Farnborough R.A.F.

Display by Gp. Capt. L. S. Snaith in July of that year. After a period in store at Hendon and London Airport, it was transferred to Upavon in 1962. A third 504K, c/n R3/LE/61400, which had been stored for many years by the Shuttleworth Trust at Old Warden, was rebuilt by apprentices at the Chadderton works of A. V. Roe and Co. Ltd. Fictitiously numbered *E3404*, this machine flew again in 1955 and took part in the film "Reach for the Sky". It is still flown on rare occasions, as at the Fifty Years of Military Aviation display at Upavon on June 16, 1962.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Australian Aircraft and Engineering Co. Ltd., Sydney, N.S.W., Australia
The Brush Electrical Engineering Co. Ltd., Loughborough
Canadian Aeroplanes Ltd., Toronto, Canada
The Eastbourne Aviation Co. Ltd., Eastbourne
The Grahame-White Aviation Co. Ltd., Hendon Aerodrome, London, N.W.9
Harland and Wolff Ltd., Belfast
The Henderson Scottish Aviation Factory, Aberdeen
Hewlett and Blondeau Ltd., Oak Road, Leagrave, Luton, Beds.
The Humber Motor Co. Ltd., Coventry
Morgan and Co., Leighton Buzzard, Beds.
Nakajima Hikoki Seisaku Sho, Ohta-Machi, Tokyo, Japan
Parnall and Sons, Mivart Street, Eastville, Bristol
Frederick Sage and Co. Ltd., Peterborough and London
S. E. Saunders Ltd., East Cowes, Isle of Wight
Savages Ltd., King's Lynn, Norfolk
Société Anonyme Belge de Constructions Aéronautiques, Haren, Brussels, Belgium
The Sunbeam Motor Car Co. Ltd., Wolverhampton
Yokosuka Naval Arsenal, Japan

Power Plants:
(Avro 504J) One 80 h.p. Le Rhône
One 100 h.p. Gnome Monosoupape
(Avro 504K) One 90 h.p. R.A.F. 1A
One 100 h.p. Gnome Monosoupape
One 90 h.p. Thulin
One 100 h.p. Curtiss K.6
One 100 h.p. Sunbeam Dyak
One 110 h.p. Le Rhône
One 130 h.p. Clerget
One 150 h.p. Bentley B.R.1
One 170 h.p. A.B.C. Wasp I
One 220 h.p. Hispano-Suiza

Dimensions: Span 36 ft. 0 in. Length (rotary engines) 29 ft. 5 in. (Dyak) 28 ft. 11 in. Height 10 ft. 5 in.
Wing area 330 sq. ft.

Weights and Performances (Avro 504K):

	100 h.p. Gnome Monosoupape	110 h.p. Le Rhône	100 h.p. Dyak
Tare weight	1,100 lb.	1,231 lb.	1,320 lb.
All-up weight	1,800 lb.	1,829 lb.	1,857 lb.**
Maximum speed	82 m.p.h.*	90 m.p.h.	70 m.p.h.
Cruising speed	—	78 m.p.h.	—
Climb to 8,000 ft.	—	6·5 min.	—
Service ceiling	13,000 ft.	16,000 ft.	—
Endurance	3 hours	3 hours	2¾ hours
Range	—	250 miles	—

*At 6,500 ft. **2,400 lb. with 220 h.p. Hispano-Suiza (see page 118).

Avro 504J Production:

Serial range	Manufacturer	Serial range	Manufacturer
C4301 to *C4500*	A. V. Roe	**D5451* to *D5550*	A. V. Roe
**C5751* to *C6050*	Harland & Wolff	**D6251* to *D6400*	Brush
D1 to *D200*	A. V. Roe	**D7501* to *D7800*	A. V. Roe
D4361 to *D4560*	Sunbeam	**E1601* to *E1900*	A. V. Roe

*Some completed as Avro 504K and Avro 504N.

Avro 504K Production:

(*a*) **Wartime deliveries**

Serial range	Manufacturer	Serial range	Manufacturer
D1976 to *D2125*	Sage	*E3404* to *E3903*	A. V. Roe
D5851 to *D5950*	Henderson Scottish	*E4104* to *E4303*	Humber
D7051 to *D7200*	Hewlett & Blondeau	*E4324* to *E4373*	Eastbourne
D8781 to *D9080*	Grahame-White	*E6737* to *E6786*	Morgan
D9281 to *D9380*	Parnall	*E9207* to *E9506*	Grahame-White
E301 to *E600*	Harland & Wolff	*F2233* to *F2332*	Brush
E2901 to *E3050*	Morgan	*F2533* to *F2632*	Sunbeam
E3051 to *E3150*	Savage	*F8696* to *F8945*	Sage
E3254 to *E3403*	*Parnall		

*c/n commenced P.L.6000.

(*b*) **Later deliveries**

Serial range	Manufacturer	Serial range	Manufacturer
**F9697* to *F9922*	Hewlett & Blondeau	*H6543* to *H6842*	Humber
H202 to *H350*	Henderson Scottish	*H7143* to *H7562*	Hewlett & Blondeau
H1896 to *H2145*	Sunbeam	*H9513* to *H9812*	Grahame-White
H2146 to *H2645*	A. V. Roe	*H9813* to *H9912*	Sage
**H2946* to *H3195*	Brush	†*J731* to *J1230*	A. V. Roe
H5140 to *H5239*	A. V. Roe	***J6896*	R.A.F. Halton
H5240 to *H5289*	Eastbourne	*J8331* to *J8380*	A. V. Roe

*Some completed as Avro 504N.
**Built from parts of *H2976* and *H6593*.
† Contracts awarded November 1, 1918 for the construction of *J2142* to *J2241* (Henderson Scottish); *J3992* to *J4091* (Hewlett and Blondeau); *J5092* to *J5191* (Sage); and *J5492* to *J5591* (Savage) were cancelled.

Service Use: (With specimen serials as on page 65).

(*a*) By the R.A.F. at East Retford, Throwley, and Newmarket; Central Flying School Upavon, *E3567*, *H2930*; Nos. 1, 2, 3 and 5 Flying Training Schools; No. 4 Flying Training School, Abu Sueir, *E3493*, *E3545*, *H3026*, *J8376*; R.A.F. College, Cranwell, *F8798*, *H7417*; No. 10 Training Sqn., Gosport, *D4388*, *D4441*, *D7051*; No. 186 Development Sqn.; No. 24 (Communications) Sqn.; Nos. 600, 601, 602 and 603 Sqns., Auxiliary Air Force.

(*b*) By the American Expeditionary Force, Third Instruction Centre, Issoudun, France, *D9038* (renumbered *1668*).

(*c*) By Fleet Air Arm training units at Leuchars and Netheravon.

Experimental Avro 504Ks used at the R.A.E., Farnborough:

D8837 Used for static strength tests prior to 8.18

E3269 C.T.E. petrol control valve tests 9.18; metal (including Vickers) wing tests 4.7.19 to 1.6.20; turn indicator tests 5.20; plug, fuel, temperature and Tampier Needle/Bloctube carburettor tests by C Flight up to 6.22; further steel wing tests 8.22; lateral control at low speeds until 2.5.25

E3621 Steel spar tests commenced 20.5.19, destroyed 14.7.19 in fatal air collision over Farnborough with S.E.5A *D7014*

F2234 Stall indicator, Holt flare, navigation light and Adamchick undercarriage tests 11.6.23 to 24.4.25

F8857 Parachute tests 2.7.19 to 3.11.19; turn indicator tests 13.1.20; accident taking off from Laffan's Plain 16.1.20

F8940 Steel wing and accelerometer tests 28.7.21 to 11.21; low speed lateral control tests up to 8.22; F/O Bouchier flew it in landing contest, Hendon 29.6.22; automatic control recorder tests from 11.8.22; airscrew tests 4.23

H2202 From Martlesham 28.7.22 for Tampier needle/Bloctube carburettor tests by Engine Research Flt., left for Kenley 18.12.22

H2214 Leitner-Watts steel airscrew tests, commencing with ground runs 20.9.21; lateral control tests 8.22; automatic control recorder tests 15.9.22 to 20.6.23; lateral control movement recorder tests from 26.6.24



F8940, one of the Avro 504Ks modified at the R.A.E., Farnborough, in 1922 for low speed lateral control tests. (*P. T. Capon Photo.*)

H2365 To Wireless and Photographic Flt. 17.6.24 for short wave telephony and night flying equipment trials to at least 7.2.25

H2402 Steel wing tests 22.1.19 to 1.3.20; revolving clear view windscreen tests 10.11.20 to 1.12.20; instrument, control column force recording, accelerometer, low speed lateral control, fuel pump, Mk. IV sextant and clinometer tests by A Flight up to 8.22; undercarriage collapsed 18.3.25

J7556 Two Avro 504Ks *A 101* and *A 102*, equipped with Sperry Mark A gyroscopes and radio control gear, were acquired 8.24 from the Sperry Gyroscope Co., New York. To the R.A.E. Instrument Flt. 1.11.24 for research into automatically controlled flight. Only the second aircraft, re-serialled *J7556*, was used; flown on six occasions 3.25 to 12.26



The Avro 527 with 150 h.p. Sunbeam engine. (*Imperial War Museum Photo Q.63792.*)

Avro 527 and Avro 528

While the Avro 523 Pike was under construction in the Manchester works, A. V. Roe and Co. Ltd. were also building a modified, two seat version of the Avro 504G for the Royal Flying Corps. It was fitted with a 150 h.p. Sunbeam engine and a standard central skid undercarriage but retained the fixed fin normally fitted only to R.N.A.S. machines. The mainplanes were standard Avro 504K units of 36 ft. span with which it was designated Avro 527, and a second version with a span of 42 ft. was also considered under the designation Avro 527A.

The machine was not a success, the rate of climb was poor, and as on the Avro 519 the radiator and twin exhaust stacks seriously obstructed the pilot's forward view.

Type number Avro 528 was given to a similar but more powerful aeroplane ordered by the Admiralty and fitted with a 225 h.p. Sunbeam engine. This machine followed the Avro 523A Pike through the works in July–August 1916 but no other information concerning it or the Avro 527 has survived.

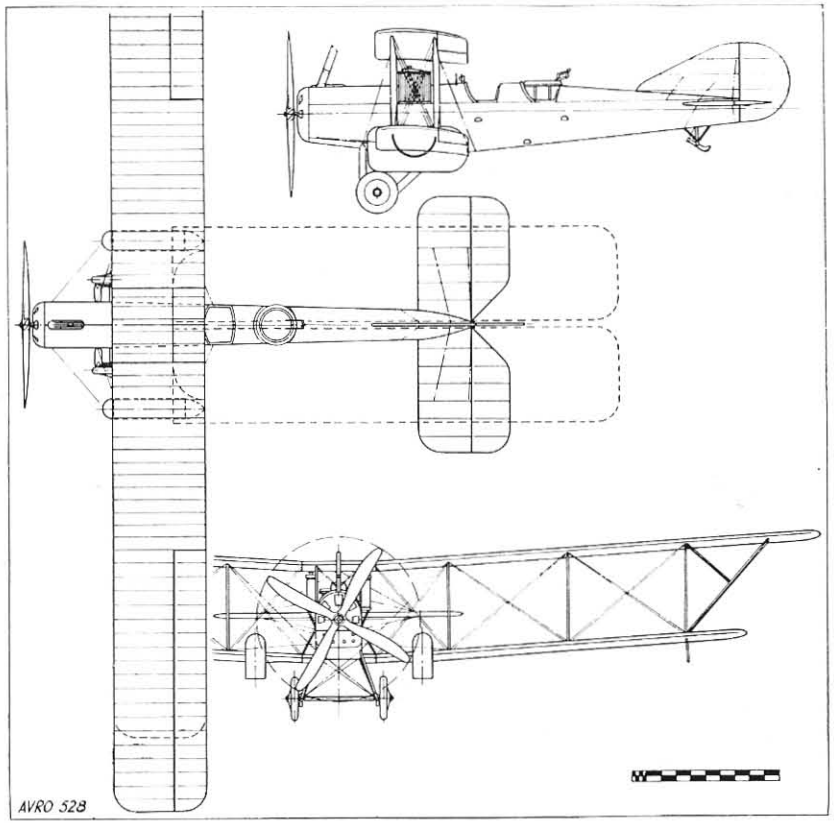
SPECIFICATION AND DATA

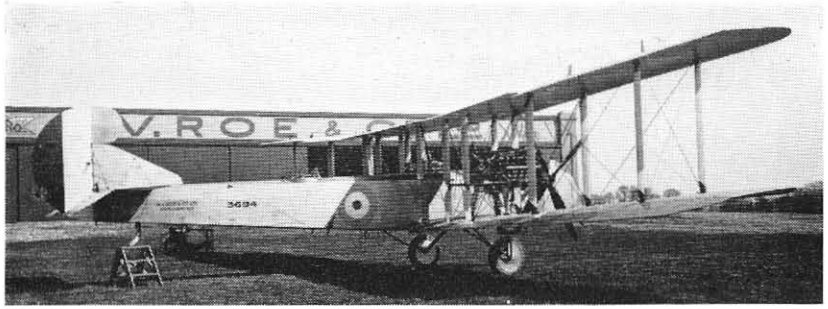
Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 527 and 527A) One 150 h.p. Sunbeam
(Avro 528) One 225 h.p. Sunbeam

Dimensions: (Avro 527) Span 36 ft. 0 in. (Avro 527A) Span 42 ft. 0 in.
(Avro 528) Span (upper) 65 ft. 0 in. (lower) 55 ft. 0 in.

Production: (Avro 527) One aircraft only to Works Order 2100
(Avro 528) One aircraft only to Works Order 2350



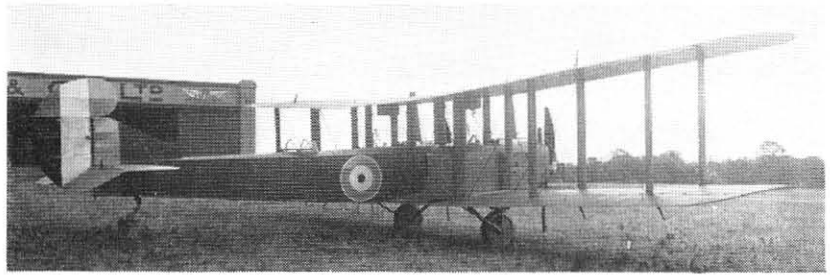


3694, the sole Avro 529, at Hamble in April 1917.

Avro 529

In 1916 the Admiralty ordered two enlarged versions of the Pike for long range bombing duties. Unnamed and known only as the Avro 529 and 529A, they had three-bay folding wings rigged without dihedral, and although closely resembling the Pike were distinguishable from it by the rudder shape. That of the Pike was flat topped with a straight bottom edge to the balance portion, but those of the Avro 529s were curved with a semi-circular balance area.

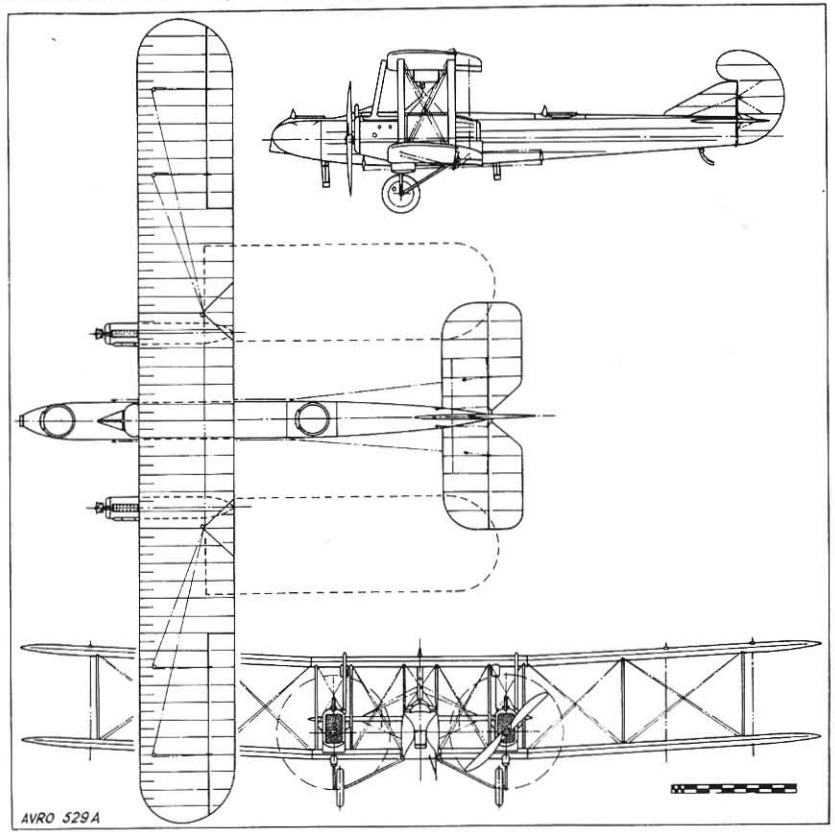
Whereas the first aircraft was built wholly in Manchester and assembled at Hamble, the second was sent there in unfinished state to make way for increased Avro 504K production at Manchester. The Avro 529, first flown in April 1917, was powered by uncowled 190 h.p. Rolls-Royce Falcons mounted at mid-gap and driving opposite handed airscrews. The Avro 529A, flown at Hamble in the following October, had two 230 h.p. Galloway-built B.H.P. engines which were fully cowled and housed in nacelles on the lower mainplane. Radically different installations called for two distinct types of fuel systems and in the Avro 529 petrol was carried in a 140 gallon tank in the centre fuselage. On the Avro 529A each nacelle carried its own 60 gallon supply with small wind-driven pumps to raise the fuel to a 10 gallon gravity tank above the engine.



3695, the Avro 529A, identified by low set nacelles.

Lewis guns were mounted on Scarff rings over front and rear cockpits and the rear gunner was provided with emergency dual control. The front gunner also acted as bomb aimer and steered the pilot on to target with the aid of a Gosport speaking tube. On the 529A, which carried twenty 50 lb. bombs stowed nose upwards inside the fuselage between the spars of the lower wing, he was able to use a projecting prone position in the cockpit floor.

Apart from poor elevator control (a shortcoming of both types), the performance of the Avro 529A was very good on such low power, asymmetrical flying being particularly easy. Nevertheless no production contract materialised and only the prototypes were built.



SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 529) Two 190 h.p. Rolls-Royce Falcon
(Avro 529A) Two 230 h.p. B.H.P. (Galloway-built)

Dimensions, Weights and Performances:

	Avro 529	Avro 529A
Span	63 ft. 0 in.	64 ft. 1 in.
Length	39 ft. 8 in.	39 ft. 8 in.
Height	13 ft. 0 in.	13 ft. 0 in.
Wing area	922½ sq. ft.	910 sq. ft.
Tare weight	4,736 lb.	4,361 lb.
All-up weight	6,309 lb.	7,135 lb.
Maximum speed	95 m.p.h.	116 m.p.h.
Climb to 5,000 ft.	—	7 min. 0 sec.
Climb to 6,500 ft.	11 min. 25 sec.	—
Ceiling	13,500 ft.	17,500 ft.
Endurance	5 hours	5 hours 15 min.

Production: Prototypes only under Contract C.P.122495/16 with R.F.C. serials *3694* (Avro 529) and *3695* (Avro 529A)



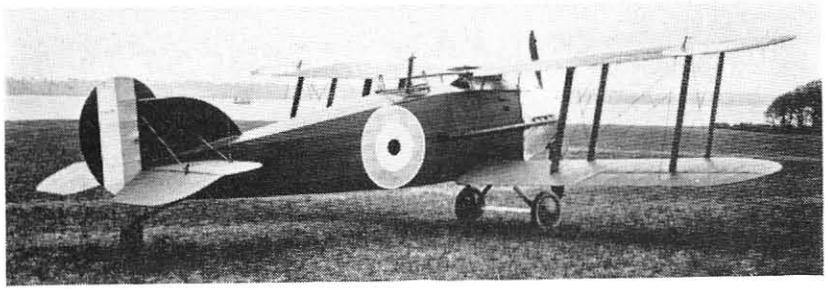
The Avro 530 two seat fighter as originally built with 200 h.p. Hispano-Suiza engine.

Avro 530

The Avro 530, first flown in July 1917, was a two seat fighter which failed to secure a production contract in the face of competition from the celebrated Bristol Fighter because of non-availability of engines. The 300 h.p. water-cooled Hispano-Suiza was not obtainable when required and the machine flew with a 200 h.p. Hispano-Suiza. Even on the lower power the performance of the Avro 530 rivalled that of the Bristol and it might still have become one of the famous fighters of the First World War had not almost all 200 h.p. Hispano-Suiza engines been earmarked for the S.E.5A.

Built at Manchester and erected and flown at Hamble, the Avro 530 was an unusually clean two bay biplane with a tail unit resembling that of the first Pike. Its unusually deep fuselage was of wire braced, box-girder construction with the fabric covering stretched over formers to give a more streamlined shape. The engine mounting consisted of strutted duralumin girders. The pilot occupied the front cockpit but the fuselage was so deep at this point that it almost filled the mainplane gap, leaving only enough room for a single Vickers gun in a plywood fairing on top of the fuselage. The top wing was thus on a level with the pilot's eyes, ensuring adequate view in all upward and forward directions while a rear gunner armed with a single Lewis gun on a Scarff mounting commanded the downward and rearward view.

The fabric covered, wooden mainplanes were of R.A.F.14 section and engine cooling was by means of a large frontal radiator. In the original form of the machine the lines of the short, blunt nose were improved by fitting a hollow, open-fronted metal spinner. The famous Avro skid-type under-carriage gave place to a new low-drag unit comprising two narrow Vees faired with metal sheeting and braced by an internal Vee strut. Landing speed was reduced by trailing edge flaps actuated by a handwheel in the pilot's cockpit. They were fitted to both upper and lower mainplanes between the inboard ends of the ailerons and the fuselage.



The Avro 530 with 200 h.p. Sunbeam Arab, enlarged fin and flap-less mainplanes.

In an attempt to solve the engine supply problem, the Avro 530 was afterwards re-engined with a 200 h.p. Sunbeam Arab and modified in various ways. An unfaired, wide angle Vee undercarriage was fitted; there was no spinner; the tail fin was larger and more gracefully curved; and new R.A.F.15 section mainplanes were fitted. These were without flaps but had long-span ailerons and metal cuffs to fair the ends of the interplane struts into the wing.

In view of its deep and capacious fuselage, the Avro 530 was offered in 1920 as a high speed touring aeroplane with comfortable tandem cockpits above a large baggage compartment. There is no evidence that this modification took place and the machine did not receive a civil registration.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants One 200 h.p. Hispano-Suiza
One 200 h.p. Sunbeam Arab

Dimensions: Span 36 ft. 0 in. Length 28 ft. 6 in.
Height 9 ft. 7 in. Wing area 325½ sq. ft.

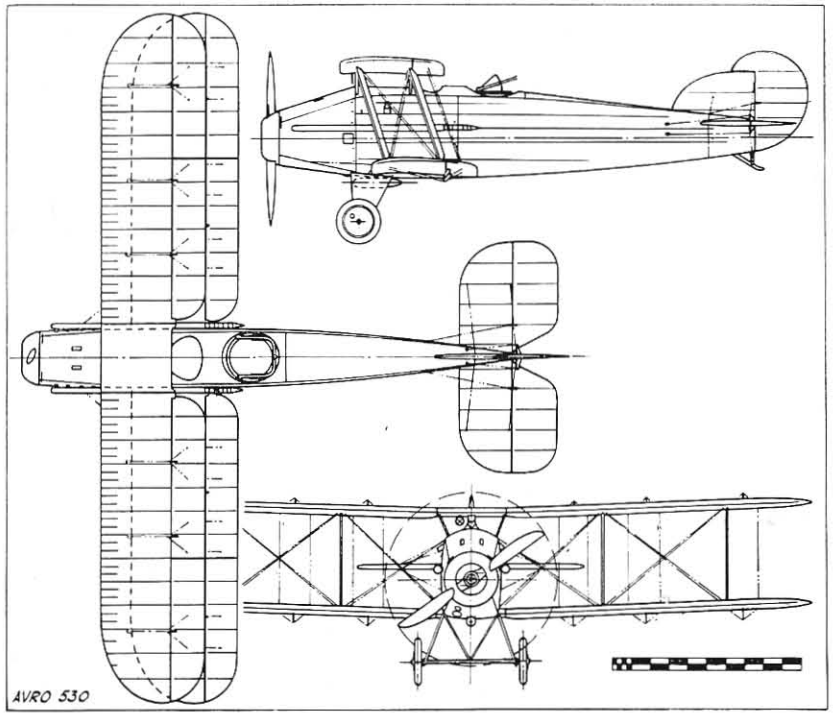
Weights: Tare weight 1,695 lb. (1,760 lb.)
All-up weight 2,680 lb. (2,500 lb.)

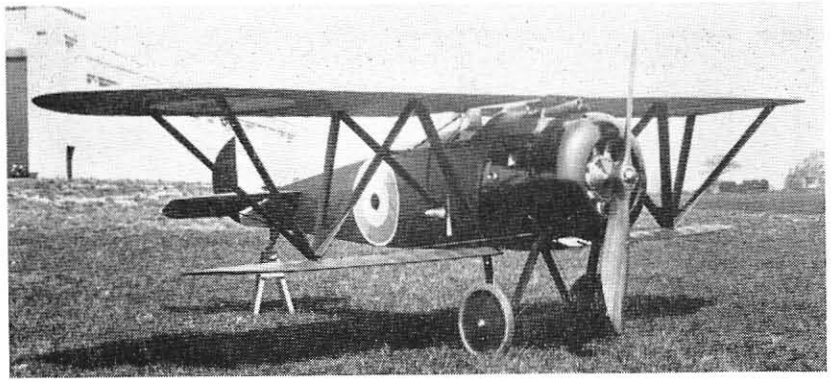
Performance:

Maximum speed	114 m.p.h. (118 m.p.h.)
Cruising speed	95 m.p.h. (102 m.p.h.)
Climb to 5,000 ft.	6 min. 30 sec. (5 min. 30 sec.)
Ceiling 18,000 ft.	Endurance 4 hours

Production: One prototype only, to Contract A.S.425/17/C, Works Order number believed 3800

Note—Estimated figures for proposed civil version in parentheses.





The Avro 531 Spider single seat fighter. (*Avro Photo.*)

Avro 531 Spider

First flown at Hamble in April 1918, the Spider was an unsponsored private venture single seat fighter in which many Avro 504K components were used for speed of manufacture. To this end a shortened rear fuselage of conventional construction with spruce longerons was married to a standard Avro 504K front fuselage and the engine was a 'borrowed' 110 h.p. Le Rhône. There seems little doubt that the Avro company hoped that the Spider would replace the single seat Avro 504K night fighter in the Home Defence Squadrons. To simplify rigging (a time consuming operation not acceptable to squadrons in the field) all flying and landing wires were replaced by very rigid welded steel Warren girder interplane bracing. This comprised six faired steel tubes arranged in three inverted triangles on each side, anchored to the main spars of the upper mainplane and to the front spar of the lower. Ailerons were fitted only to the upper wing, the lower being shorter and with a chord of only 2 ft. 6 in.

The simple steel Vee strut undercarriage was reminiscent of the Avro 530 in modified form and the attempt made in the earlier design to improve substantially the pilot's field of vision was carried a stage further in the Spider by siting the cockpit under a circular aperture in the centre section. This was mounted close to the fuselage so that the pilot's head protruded above it. Armament consisted of a single synchronised Vickers gun on top of the fuselage and slightly to starboard of centre.

The little fighter was a delight to handle, with powerful and well harmonised controls which made it extremely manœuvrable, and more than a match for many of its contemporaries. Performance was further enhanced by fitting a 130 h.p. Clerget and drawings were made for the installation of a 150 h.p. Bentley B.R.1 rotary or a 170 h.p. A.B.C. Wasp I radial. Well-known pilots

were invited to fly it in off duty hours and to give their opinions, for which purpose it was at the School of Special Flying, Gosport, from April 27 to May 18, 1918 and again on July 13. In this way the Spider became such a topic of conversation that the Air Ministry could not fail to take note of it. Nevertheless it was not ordered into production because the Sopwith Snipe had already been standardised as the R.A.F.'s next single seat fighter. The Spider was therefore used for experimental work which included benzole fuel tests at Alexandra Park in August 1919.

A considerably modified version of the Spider was allotted type number Avro 531A. This had conventional two-bay, wire braced mainplanes rigged with a considerable stagger and using 504K-type interplane struts. With the 130 h.p. Clerget rotary the Avro 531A had a performance similar to that of the Spider. Serial allocation suggests that construction of only one Avro 531 and one Avro 531A was undertaken. There is no means of proving that the latter ever existed as such and it is probable that that machine donated its fuselage, undercarriage and tail unit to the civil Avro 538, and first flew in this form.

The Avro 538 emerged from the flight shed at Alexandra Park, Manchester, in May 1919 registered *K-132*, a temporary civil marking later changed to *G-EACR*. As far as is known these symbols were never carried and the machine's main adornment was the word AVRO in the usual enormous black letters. Although powered by a 150 h.p. Bentley B.R.1 and intended as a racer, a main spar defect limited the machine's activities to straight and level flight, and a notice to this effect was displayed in the cockpit. Bearing fleet number 7, the Avro 538 was used solely by the Avro Transport Company's chief engineer J. C. C. Taylor, who flew it around the joyriding sites in order to sign out the Avro 504Ks.



The Avro 538 communications machine of the Avro Transport Company, at Birkdale Sands, Southport, 1919.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Clifton Street, Miles Platting, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants:

(Avro 531)	One 110 h.p. Le Rhône
	One 130 h.p. Clerget
(Avro 531A)	One 130 h.p. Clerget
(Avro 538)	One 150 h.p. Bentley B.R.1

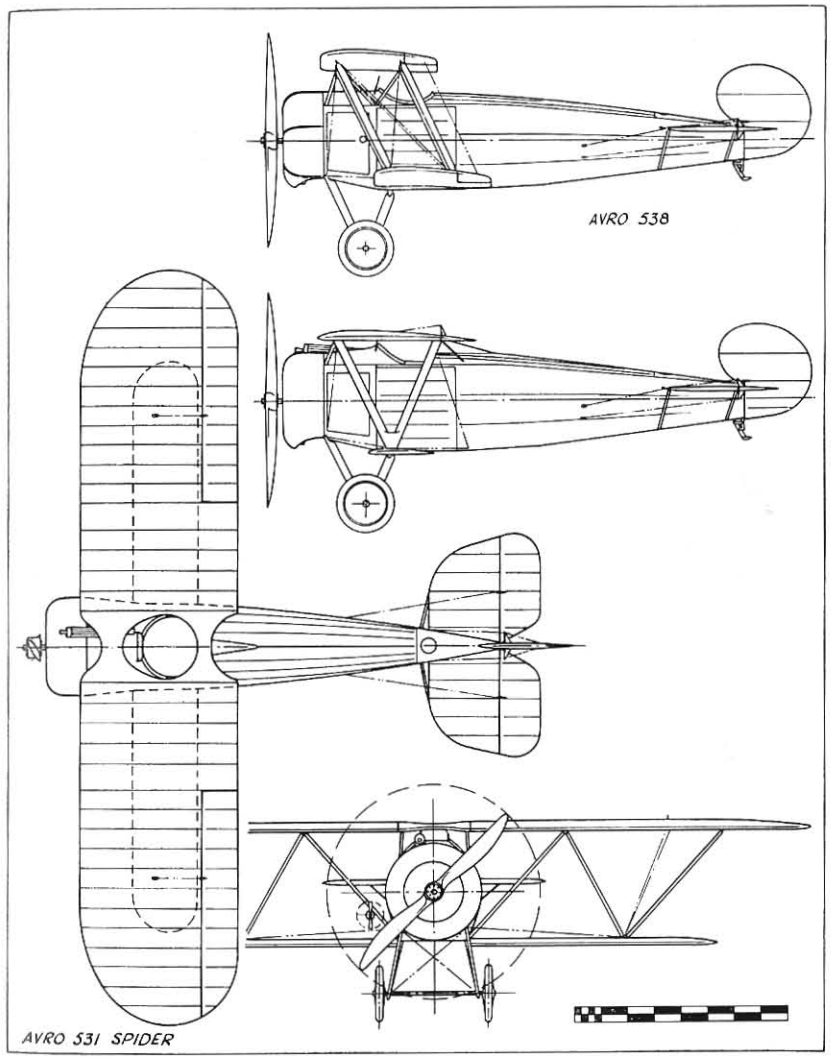
Dimensions, Weights and Performances:

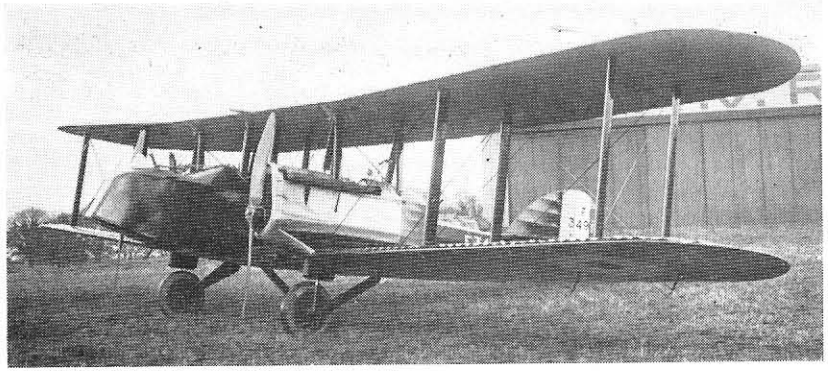
	Avro 531 Spider		Avro 531A	Avro 538
	Clerget	*Bentley	Clerget	Bentley
Span (upper)	28 ft. 6 in.	28 ft. 6 in.	28 ft. 0 in.	28 ft. 0 in.
Span (lower)	21 ft. 6 in.	21 ft. 6 in.	27 ft. 0 in.	28 ft. 0 in.
Length	20 ft. 6 in.	20 ft. 6 in.	20 ft. 6 in.	20 ft. 6 in.
Height	7 ft. 10 in.	7 ft. 10 in.	8 ft. 6 in.	8 ft. 6 in.
Wing area	189 sq. ft.	189 sq. ft.	—	210 sq. ft.
Tare weight	963 lb.	1,148 lb.	960 lb.	975 lb.
All-up weight	1,517 lb.	1,734 lb.	1,514 lb.	1,400 lb.
Maximum speed	120 m.p.h.	124 m.p.h.	120 m.p.h.	125 m.p.h.**
Climb to 3,500 ft.	—	2 min. 12 sec.	—	—
Climb to 5,000 ft.	4 min. 0 sec.	—	4 min. 0 sec.	4 min. 0 sec.
Climb to 10,000 ft.	—	—	—	10 min. 0 sec.
Ceiling	19,000 ft.	—	19,000 ft.	—
Endurance/Range	—	2½ hours	3 hours	320 miles

*Estimated figures. **Cruising speed 108 m.p.h.

Production: (Avro 531 and 531A) Serial allocation *B3952* and *B3953*; (Avro 538) One aircraft only, *K-132/G-EACR*, c/n 538/1, registered to A. V. Roe and Co. Ltd. 25.5.19, s.o.r.* 9.20

*Abbreviation used throughout to indicate 'struck off register'.





F3492, the Siddeley Puma engined Avro 533 Manchester Mk. II.

Avro 533 Manchester

The Manchester of 1918, final variation on the Pike/Avro 529 theme, was a three seat, twin engined bomber or photo reconnaissance fighter designed to Air Ministry requirements round two of the new 320 h.p. A.B.C. Dragonfly I seven cylinder radial engines. Unlike its forebears the Manchester was constructed entirely at Hamble and its deeper, more shapely fuselage giving improved crew accommodation was but one of many refinements, others including a graceful (almost de Havilland-shaped) rudder, and ailerons balanced by means of 'park bench' auxiliary aerofoils.

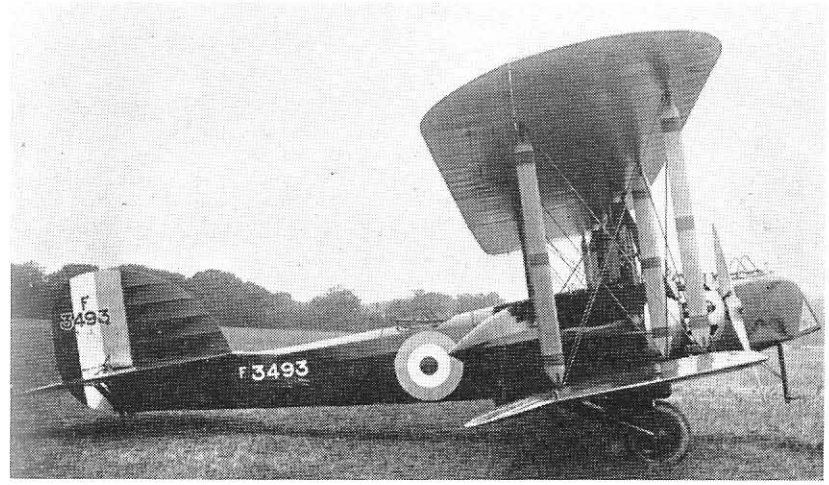
Erection of the first Manchester was completed by October 1918 after which it was dismantled for covering, during which the opportunity was taken to fit two 300 h.p. Siddeley Puma high compression, watercooled engines. This was to prevent interruption of flight tests by the non-delivery of the Dragonfly engines which had run into a number of teething troubles. The Pumas arrived at Hamble in November, and thus powered, the aircraft was known as the Avro 533A Manchester Mk. II. First flights took place early in December 1918 and the Mk. II aircraft *F3492* consequently had an earlier serial than the Mk. I which followed. On December 20 *F3492* went to No. 186 Development Squadron, Gosport, where it remained until at least January 9, 1919 before proceeding to Martlesham in the following March. Official trials lasted until September 1919 when *F3492* returned to Hamble to be fitted with Napier Lions, a project which did not materialise.

Delivery of the Dragonfly engines in December 1919 enabled the second airframe *F3493* to be completed as the Manchester Mk. I. After prolonged manufacturer's tests it was flown from Hamble to Martlesham for official trials in October 1919, the journey via Winchester, Basingstoke, London and Chelmsford occupying 90 minutes.

Apart from the engines and the revised nacelle shape of the Mk. I which decreased the effective area of the lower wing by 4 sq. ft., the two marks of

Manchester differed only in their tail units. Both had balanced rudders but all tail surface areas were greater in the Mk. I which had taller vertical surfaces and an unbalanced elevator. That of the Mk. II was horn balanced.

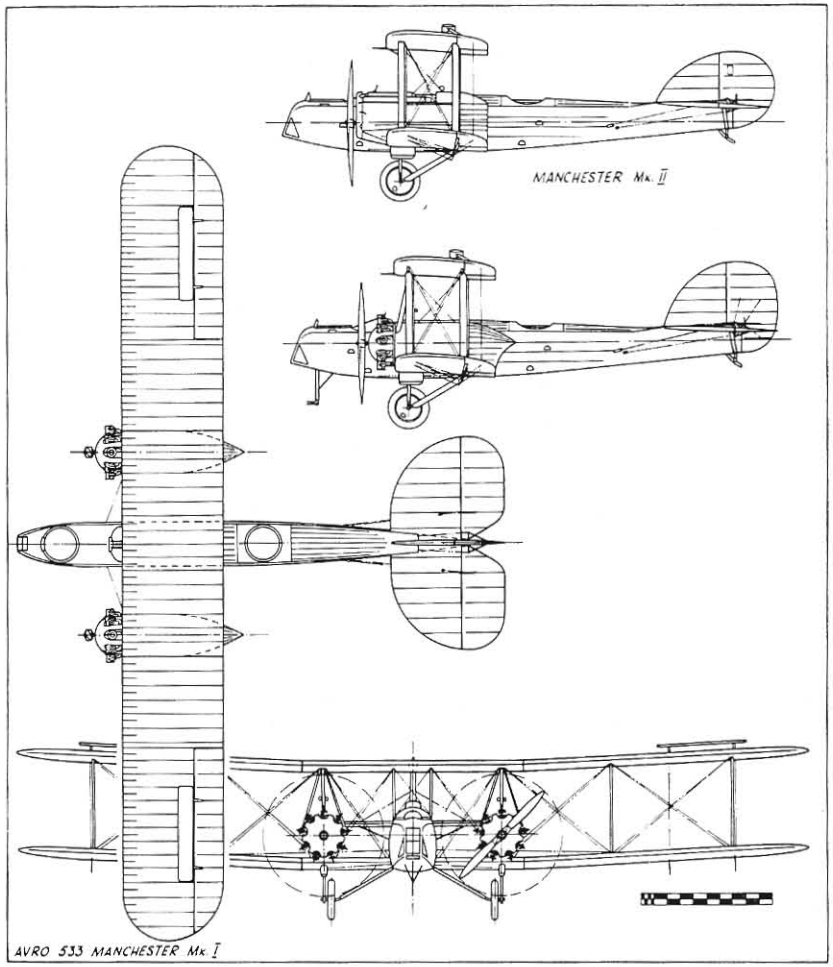
The performance of both marks was quite remarkable on comparatively low power and despite their size could be looped and spun, but the need for a bomber of this type disappeared when the war ended. A third airframe, intended as the Manchester III with two 400 h.p. Liberty engines, was completed but the engines were never fitted. The jigs were then dismantled and A. V. Roe's war effort was at an end.

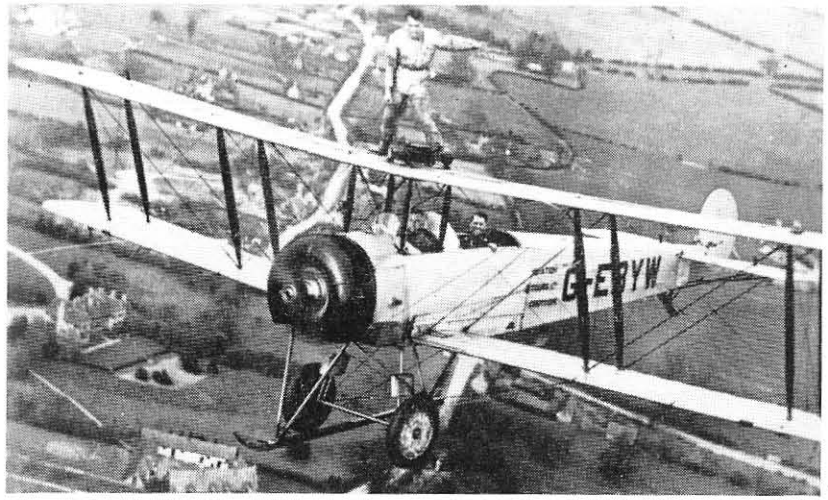


F3493, the A.B.C. Dragonfly powered Avro 533 Manchester Mk. I.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Hamble Aerodrome, near Southampton, Hants.	
Power Plants:	(Mk. I)	Two 320 h.p. A.B.C. Dragonfly I
	(Mk. II)	Two 300 h.p. Siddeley Puma high compression
	(Mk. III)	Two 400 h.p. Liberty 12
Dimensions:	Span 60 ft. 0 in. Length 37 ft. 0 in. Height 12 ft. 6 in. Wing area (Mk. I) 813 sq. ft. (Mk. II) 817 sq. ft.	
Weights:	(Mk. I)	Tare weight 4,887 lb. All-up weight 7,390 lb.
	(Mk. II)	Tare weight 4,574 lb. All-up weight 7,158 lb.
Performance:	(Mk. I)	Maximum speed 112 m.p.h.
		Climb to 10,000 ft. 14 min. 20 sec.
		Ceiling 19,000 ft. Endurance 5¾ hours
	(Mk. II)	Maximum speed 119 m.p.h.
		Climb to 10,000 ft. 16 min. 30 sec.
		Ceiling 17,000 ft. Endurance 3¾ hours
Production:	*F3492* (Manchester Mk. II); *F3493* (Manchester Mk. I); *F3494* (Manchester Mk. III) airframe only	





The Golden Age of barnstorming—Martin Hearn riding the top wing of Aviation Tours' Avro 504K *G-EBYW circa* 1933.

Avro 504K (civil)

The vast armada of Avro 504Ks rendered surplus by the 1918 Armistice included not only wartime training veterans but also large batches of new machines at storage units or still in the factories. An offer by A. V. Roe and Co. Ltd. to repurchase them *en bloc* was refused on the grounds that the Disposal Board found it impossible to compute the precise number of saleable aircraft. Sales therefore began by public auction at No. 1 Aircraft Salvage Depot, Hendon, but in 1920 Handley Page Ltd. bought all Disposal Board stocks and the 504Ks were thereafter marketed by its subsidiary, the Aircraft Disposal Co. Ltd. of Croydon. Trade was brisk despite the late G. P. Olley's forced landing on March 31, 1920 in Southwark Park pond in the company's demonstrator *G-EAHW* (130 h.p. Clerget). Foreign and Commonwealth governments made considerable inroads into stocks but even greater numbers were sold for civilian use. Low first cost and a seemingly endless spares backing, made the Avro 504K the only military aircraft of the period to find lasting favour as a civil type. Between 1919 and 1930 over 300 were allotted civil registrations in Britain alone and before the advent of the D.H. Moth in 1926 the Avro 504K was the most common British aeroplane. The majority had the dual controls removed and the decking cut away to make room for a third seat but a few were used for flying instruction and the total included a number ferried abroad in temporary civil marks.

Civil flying was sanctioned in Britain at Easter 1919, a memorable Bank Holiday when A. V. Roe's immortal trainer embarked on an even greater career as a pleasure trip machine. Its usefulness extended over two decades

and its name will be linked for ever with the halcyon days of itinerant joy-riding, the story of which falls into four clearly defined periods.

Excited by the deeds of great wartime pilots, the public developed a thirst for flying which earned every airworthy 504K a handsome living for the rest of 1919. Despite an ambitious essay into organised pleasure flying by the Avro company, lesser concerns also made a great deal of money, particularly in Scotland. Quick to fill the gap when Avro withdrew from the business in 1920, many former R.A.F. pilots bought 504Ks in the hope of reaping similar rewards but over 50 such mushroom enterprises were ended within the year by the trade slump. The third period, which lasted until the end of the decade, saw Avro pleasure flight business reduced to a number of old established firms run by a handful of seasoned pilots whose lives were dedicated to the game. Their eventual absorption into the great air displays of the 1930s brought the career of the 504K to an end as it had begun, in organised joy flying on the grand scale.

Genesis A. V. Roe and Co. Ltd. started operations at Hamble at Easter 1919 with three Avro 504Ks (100 h.p. Gnome Monosoupape) in military marks. Piloted by G. L. P. Henderson, H. A. Hamersley, F. Warren Merriam and others, they carried 359 passengers at £1 a head on the first day! Some 3½ weeks later the Avro Transport Company was set up to run a daily return service between Alexandra Park, Manchester and Blackpool Sands via Southport. The inaugural flight, made on May 24 by four 3 seat 504Ks (110 h.p. Le Rhône), carried Avro director John Lord and a selection of civic dignitaries. During the 18½ week life of the service, bad weather only prevented 28 of the 222 scheduled flights and when the route closed for the winter (and for ever) on September 30, 8,730 miles had been flown without a forced landing.



Avro Transport Company joyriding 504K *E4359/G-EABJ*, Fleet No. 3, on the beach at Blackpool in 1919. (*Photo courtesy of J. C. C. Taylor.*)

Inspired by results at Hamble, the Avro Transport Company launched a nation-wide joyriding programme and put G. L. P. Henderson in charge. As prelude to this assignment he flew a brand new 504K (110 h.p. Le Rhône) *H2586/G-EAEV* into 6th place in the Aerial Derby at Hendon on June 21, 1919 at an average speed of 75·22 m.p.h. Leading pilots of the day whom he had appointed to take charge of 'Southern Area' operations were already hard at it at Hounslow Heath (Maj. A. G. Taylor); Manston (Capt. Duncan Davis); Southsea/Eastney (F/Lt. E. A. Sullock); Weston-super-Mare sands (Capt. D. G. Westgarth-Heslam); Brighton/Patcham/Blatchington Farm (Capt. D. I. M. Kennard); Swansea/Brynmill (F. G. M. Sparks); and Porthcawl (Capt. E. D. C. Hearne). The 'Northern Stations' were Blackpool/South Shore (Capt. W. G. R. Hinchliffe); Southport/Birkdale Sands (Capt. Collison); Fleetwood/Scale Hall and Morecambe Sands (Lt. Macrae); Rhyl (Capt. E. Maitland Heriot); Liverpool/Waterloo Sands (machines diverted from the Manchester–Blackpool service on Wednesdays and Saturdays); Manchester/Alexandra Park (Lt.-Col. G. L. P. Henderson); and Isle of Man/Douglas Promenade/Ramsey (Lt. G. B. Moxon). Avro 504L seaplanes and Avro 536 five seaters were also used as detailed in their own chapters.

During Wakes Weeks, industrial workers, coal miners and the like spent lavishly on longer flights, looping and inverted flying and by August 1 over 10,000 passengers had been carried at Blackpool alone. Similar figures were returned at Southport where flying often continued by moonlight and one woman passenger had 15 stunt flights within a week. In mid-August a gale of unprecedented fury struck the coast, wrought havoc among Avros pegged down with sandbags on the beaches and reduced the number in service on August 31 to 17.

At Hounslow Heath where 6,400 passengers were carried during the season, Avro 504K *E3289/G-EAAM* and an Avro 536 *K-105/G-EAAP* were chartered by the *Evening Standard* in July for daily newspaper flights to Brighton and Southsea. Another made an incredible eight hour flight from Perth to Hounslow on August 12 with 60 brace of grouse.

Led by *G-EAIH*, *'II* and *'IJ* which left the Manchester works on July 28, 1919, nine Avros (including *G-EAJQ*, *'JU*, a 536 and two 504Ls) attended the First Air Traffic Exhibition at Amsterdam in August 1919. A sustained demand for joy flights kept them in the Netherlands and the last two did not arrive back at Lympne until January 3, 1920. Meanwhile a rail strike in England had brought almost the entire fleet to Hounslow to convey passengers, newspapers, films and light freight to the provinces. The return flights were offered as a daily service to London and once again demand was far in excess of available seats. When petrol restrictions brought the season to an end the Avro Transport Company had carried over 30,000 people and flown the equivalent of 12½ circuits of the earth. The craze for flying bordered on hysteria. Garden parties without a 504K were considered unfashionable and the Swansea machine was frequently 'detached' to the Abernant Hotel, Llanwrtyd Wells, for this purpose, and when the Town Crier flew over



The Navarro Aviation Co.'s Avro 504K *D9304/G-EAEA* joyriding at Whitstable, Kent in 1919. Like so many contemporary civil aeroplanes, it flew in drab military green with R.A.F. serial.

Swansea ringing his bell in flight, the local police could hardly control the resultant crowd of would-be aviators.

Hounslow was not the only 504K pitch in the London area. Prewar premises were reopened at Hendon by the Grahame-White Aviation Co. Ltd. as the London Flying Club, a centre of fashionable society equipped with 12 Avro 504Ks acquired from the nearby Salvage Depot. Painted in carroty pink, they carried enlarged versions of their R.A.F. serials until full civil markings on white rectangles were applied some months later. Instruction was available and an attempt was made to revive Saturday afternoon pylon racing but the Avros were engaged mainly on joy flights, 5,100 tickets being sold in the public enclosures that season. They also carried the *Daily Mirror* to the Midlands during the railway strike but the concern degenerated into a country club and flying ceased at the end of 1920. Across the road at Stag Lane, the London and Provincial Aviation Co. Ltd. used a single machine *G-EABT* which was later flown at Yarmouth by T. Neville Stack and George Lusted. An eight-strong fleet (110 h.p. Le Rhône engines), flown at Northolt by the Central Aircraft Co. Ltd. included *G-EAGI* fitted with the Vee strut undercarriage of the Home Defence fighter variant. When the firm closed in 1921, chief pilot Herbert Sykes left to continue Avro joyriding on his own account at Kingsbury, Middlesex, with tours in the Midlands each summer, each of his machines being appropriately named "Psyche" in turn.

Vickers Ltd. operated south of the Thames with *G-EACV*, *'DS*, *'EY* and *'EZ* at Joyce Green, Kent. Two of these did a roaring trade at Kings Heath, Birmingham, in August and on October 10 another, piloted by Capt. Simpson, made commercial aviation history by carrying 333 lb. of tinned fish from Newcastle to Turnhouse. Croydon figured as an Avro 'pitch' from August 1919 when Aircraft Transport and Travel Ltd. started joyriding with *G-EAIO–'IS* and Sir Philip Sassoon, who was just about the first owner of a private 504K, commuted to and from Lympne in *G-EANN*.

Coastal resorts outside the Avro company's network were served in 1919-20 by the Eastbourne Aviation Co. Ltd. with 504L seaplanes and two 504Ks; by the Bournemouth Aviation Co. Ltd. with five; and by the Navarro Aviation

Co. Ltd. with three. The Bournemouth outfit ran a service to Weymouth and worked inland towns as far as Bath, while Navarro's machines *G-EADY*, *'EA*, *'EB* and *'JP* enjoyed lucrative seasons at Southend and Whitstable. Among the first concerns to offer flying instruction was the Cambridge School of Flying Ltd. of Hardwick to which record crowds were drawn by F. J. Ortweiler's aerobatics in *E3501/G-EAEC* in August 1919. Their other machine *E4118/G-EAHL* did good business at Hunstanton and during August and September 1919 two new Humber-built 504Ks *G-EAGV* and *'GW* ran a Harrogate–Hull–Scarborough service for the North Sea Aerial Navigation Company of Leeds.

Aerial Photos Ltd. of Edinburgh, owners of three (later six) 504Ks made a vigorous pleasure flight tour of St. Andrews, Rothesay, Dundee, Perth, Berwick and Montrose. They carried 1,509 passengers, one of whom flown at North Inch, Perth, was the young Earl of Kinnoull, who four years later became the owner of a private 504K *G-EAMZ*. The Ayr–Glasgow area was served by *G-EADH*, *'HY*, *'HZ* and *'IA* of the West of Scotland Aviation Co. Ltd., Renfrew.

Smaller concerns of the period were run by Telford Rogers at Birmingham with *G-EAFQ*; *G-EAHO* (H. V. David) crashed at Aberystwyth after only three weeks; C. A. Crichton (Northern Aircraft Transport and Travel Co. Ltd.) flew *'GZ* at Sunderland; and W. G. Pudney toured rural Essex with *'JZ*, *'MI* and *'RP*. Probably the first British 'executive' aeroplane was Avro 504K *G-EANT* commissioned at Brooklands in October 1919 to assist Godfrey-Nash motor racing interests. J. D. V. Holmes, an ex R.A.F. pilot whose brother F. J. V. was a skilled aircraft engineer, pooled all available cash in May 1919 with the newly demobilised Alan J. Cobham, and bought *G-EACL*, first 504K sold by the Aircraft Disposal Co. Ltd. After its conversion to three seater by Avro at Hamble, Cobham commenced joyriding at Newbury, Wantage, Oxford and Aylesbury, but two months later *'CL* overturned in a hayfield near Northampton, after which the replacement, *G-EAIB*, worked Leicester, Nottingham and elsewhere.

The Lean Years Foreseeing the end of the boom, Avro left the joy flight business but the Holmes brothers continued through the winter at Bradford, Middlesbrough and Newcastle, Cobham alone carrying 6,000 passengers. *G-EASF*, destined to become the most famous of all joyriding 504Ks, was first flown at Warrington and Bolton in 1920 under Cobham and Holmes Aviation Co. ownership but much of the income came from free flights paid for by local newspapers. When Cobham left to join de Havillands his place was taken by J. C. C. Taylor, an experienced pilot and engineer who introduced wing walking to draw the crowds. Former Avro Transport machines *G-EAHZ* and *'KX* were acquired to work the lucrative South Wales beaches but *'IB* was sold. After overhaul at Manchester it was flown to Priory Heath, Ipswich, in 2½ hours by Capt. Anderson of the Anderson and Pool Aviation Co. on July 2, 1920. To attract custom, fares came



G-EAGI, one of the Central Aircraft Co.'s Northolt-based instructional 504Ks, retained the Vee-type undercarriage of the Home Defence fighter version.

down to 15s. 6d., a move found expedient by concerns such as J. M. Drysdale's Oxfordshire Aviation Co. which based *G-EADU* and *'GT* at Caversham, Reading; J. Blake's taxi service between Liverpool and the Isle of Man, flown by *G-EAFD* during the T.T. Races in June 1920; Ingham and Little (the Border Aviation Co.) at Carlisle and Scarborough with *G-EANQ* in 1920, and at Cockermouth and Heysham with *G-EAIA* in 1921; Summerfield and Company on the East Coast with *G-EADR* and *'EB*; and A. A. Mitchell (the Scottish Aerial Transportation Company) of Craiglockhart who carried passengers over Edinburgh in *G-EAQU*, *'QV* and four others hired from Aerial Photos Ltd. By this time Croydon joyriding was in the hands of W. G. Chapman (Leatherhead Aviation Services) with the ex Cambridge *G-EAHL*. He also sold flights at Reading, Leatherhead, Guildford and Chessington but withdrew from the business when his new 504K *G-EBAV* crashed at Slough on August 20, 1922. F. G. M. Sparks and E. A. Sullock formed the Welsh Aviation Co. Ltd. in November 1920 to revive the Swansea trade with *G-EAWK*, *'WL* and *'WM* but optimism went unrewarded and after one season they were bought out by local turf accountant Evan Williams. Only 71 hours were flown in 1922 and the new owner was drowned with pilot F. Bush when *'WK* fell into the sea in the following October.

Alexandra Park, birthplace of the 504K, housed the Midland Aviation Company equipped with *G-EADP*, *'GB* and *'LE*. It was a typical 'one season' outfit, taken over in 1922 by the Manchester Aviation Co. Ltd. which, with a smaller concern called Manchester Airways operated all over Lancashire. Three Avros *G-EADP*, *'ZW* and *'ZX* alone survived this ordeal to found the Northern Aviation Co. Ltd. in 1924. In the south C. L. Pashley (still C.F.I. of the Southern Aero Club in 1962) took 504K *G-EATU* to Shoreham for instruction and joyriding, while a more ambitious project, inaugurated by the Royal Aero Club in July 1921, sought to provide aero-

planes for the use of members. The Aircraft Disposal Co. Ltd. delivered *G-EAXY*, *'YB* and *'YC*, newly overhauled, which were raced enthusiastically at Croydon in September 1921 but lost in accidents soon afterwards.

Frank Neale (the Essex Aviation Company) who acquired *G-EBCK* from F. J. V. Holmes in 1923, did well at Epping and also on Margate beach. In the same year J. M. Drysdale's old machine *G-EADU* was sold to Renfrewshire Flying Services to join *'JZ* at the game in south west Scotland. They were not alone at Renfrew as William Beardmore and Co. Ltd. was awarded a Reserve Training contract and purchased *G-EAHY* from the West of Scotland Aviation Co. Ltd., *G-EBFV* from F. J. V. Holmes and *G-EBGY*, *'GZ* and *'IS* newly civilianised by A. V. Roe and Co. Ltd. These and *G-EBXA* (a crash replacement) flew hundreds of hours per annum until the three survivors were replaced by Bristol Type 89As in 1927 and sold to the North British Aviation Co. Ltd. at Hooton for joyriding in 1929. *G-EBLA*, originally the Reserve Training 504K at Brough, was also sold for joyriding but fell into the sea at Weymouth on June 6, 1928.

The 1923 Air Ministry Light Aeroplane Trials awakened interest in private flying and several 504Ks were thus used, including *G-EAMZ* (130 h.p. Clerget). This came out of storage as a mount for pioneer Avro test pilot F. P. Raynham in the Grosvenor Trophy Race on June 23. With rear seat faired over he flew round the Lympne–Castle Bromwich–Filton circuit at an average speed of 96·1 m.p.h. and came second. In June 1925 *'MZ* was sold to the Earl of Kinnoull (whose enthusiasm for the 504K dated from a pleasure flight at Perth in 1919) for whom Beardmore test pilot Maurice Piercy made the delivery flight to Le Bourget where it crashed only a few days later. Flying from Hendon and Brooklands, *G-EASB* was widely publicised in 1925 as the mount for the first 'aerial commercial travellers', (Tellus Super Vacuum Cleaner representatives), flown about the country by J. C. P. Phillips and C. P. B. Ogilvie. G. V. Peck (the Southern Counties Aviation Company) painted up *G-EASG* as the concern's 'A Flight' and a new machine *G-EBKS*, built from spares, as 'B Flight'. Working from Brooklands they were a familiar sight in the south and a third machine *G-EAAY* was added in 1926. This 'evergreen' was soon acquired by F. G. Miles of Shoreham along with *G-EBJE* which had been at Brooklands for some months as the private aeroplane of racing driver John Cobb. Although he is well known as the founder of Miles Aircraft Ltd., few realise that F. G. Miles flew over 2,000 hours in Avro 504Ks. In 1927 the Gnat Aero Co. Ltd. (forerunner of the Southern Aero Club) was formed at Shoreham with *G-EAJU*, *'TU* and *G-EBYB* and successfully worked the South Coast, a task in which *G-EBJE*, *'VL* and *G-AACW* of Southern Aircraft Ltd. also joined in 1928. 'Opposition' in the area was provided by the irrepressible Dudley Watt operating from Ford, Sussex with *G-AADY*, *'FJ* and *G-ABBF*. Other prominent members of the fraternity at that time were Messrs. Thomas, Griffiths and Rimmer (South Wales Airways) of Porthcawl and Swansea who kept *G-EBNH*, *'SG*, *G-AASS*, *G-ABLV* and *'LW* in turn in their hillside

hangar at Wenvoe; Messrs. L. Lewis and L. A. Jackson (later of the Shuttleworth Trust) who ran L. J. Skytrips Ltd. in the Home Counties; and Western Aviation Ltd. which worked the West Midlands with the blue and cream striped *G-EBQR* and *'XV*.

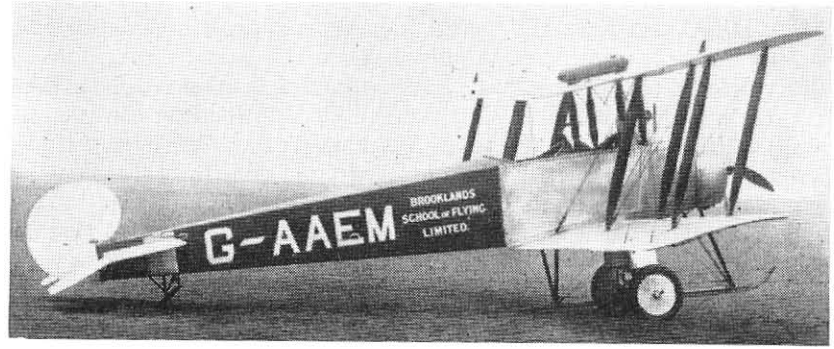
Renaissance Interest in the 504K as a private aeroplane revived in 1926. It was not easy to fly, but once mastered, was a real 'pilot's aeroplane', but unfortunately stayed economically in the air solely by joyriding's high utilisation. Thus C. L. Kent's *G-EBKR*; J. C. Don's ex Gnat *G-EAJU*; *G-EBSJ* flown at Maylands by Battlesbridge flour miller A. H. Matthews; and L. E. R. Bellairs' *G-EBVL*; soon returned to barnstorming, the last at Christchurch with F. C. Fisher. Of unique interest was *G-EBWO* rebuilt with a 100 h.p. Anzani radial at Woodley in 1928 by Phillips and Powis Ltd. for Dr. M. C. Wall (see also pages 180 and 182). After a few months it joined standard 504K *G-AAGG* at the Phillips and Powis flying school.

As the decade drew to its close another crop of small operators appeared which included R. J. Bunning at Pontypool with *G-EBSM*; Midland Aero Flights Ltd. with *G-EBYE*; Inland Flying Services Ltd. of Maylands who worked Essex fields with *G-AAFE* and *'FT*; and Aeroplane Services which spent the 1929 season at Southend using *G-AAEZ* in competition with Surrey Flying Services' *G-EBYW* at Shoebury. The latter was sold in 1930 to Aviation Tours Ltd. which plied its trade in the west country with some success, took over Western Aviation Ltd. in 1933 and expanded its fleet to five – *G-EBQR*, *'XV*, *'YW*, *G-AAYM* and *G-ABAA*. Airframes were by that time in very short supply and the last of these grand old biplanes were built from spares by Kent Aircraft Services Ltd. who produced seven with private constructor's numbers K.A.S.1 to 7 at Kingsdown, Kent in 1930–31; by G. and H. Aviations Ltd. at Stag Lane in 1930 (*G-ABAA* and *'AB*); by the Essex Flying Club who built *G-ABWK* and *'YB* in a garage at Orsett, Essex in 1932; and by C. B. Field who constructed *G-ABSL* – *'SN*, *G-ACAU* and *'AV* at Kingswood Knoll, Surrey in 1932–33. The Kent Avros flew at seaside resorts, one at Ramsgate piloted by E. Bicknell of Thanet Aviation Ltd. and another at Gravesend by P. H. Meadway. The Essex Avros, intended for a club at Abridge, went instead to Springfield, Chelmsford, in a second vain attempt to form a club. C. B. Field's machines were all sold to small concerns and on September 24, 1932 *G-ABSN* (130 h.p. Clerget) forsook its pitch at Herne Bay when London and Provincial's pilot Pegg averaged 59 m.p.h. in the Hillman Trophy Race from Maylands to Clacton and back and came 7th.

Grand Finale The useful life of the old 504K ended in the mid-30s in service with the big names of joyriding. The first of these came into existence on August 25, 1921 when the Holmes brothers re-formed as the Berkshire Aviation Co. Ltd. (later restyled Berkshire Aviation Tours







For over a decade three of the greatest names in joyriding were those of Surrey Flying Services Ltd., the Cornwall Aviation Co. Ltd. and the Brooklands School of Flying Ltd., represented here by *G-EBDP* (1922–1930); *G-EBIZ* (1924–1935); and *G-AAEM* (1929–1931).

Ltd.), operating initially at Porthcawl. Here O. P. Jones (later famous as the bearded Imperial Airways and B.O.A.C. captain) and A. L. Robinson joined the payroll. The former carried 10,000 passengers by the end of 1921 (8,000 in *G-EASF*) but left to form his own company with A. N. Kingwill in 1922, using Avros *G-EADH* and *G-EBCB*. Robinson (who succeeded in carrying 155 passengers in one day in *G-EAKX* at Wells on May 14, 1922) also went to Imperial Airways Ltd. in 1924, being replaced by J. D. Parkinson who alone carried 34,000 passengers, 10,000 of them for Berkshire in 1925. Overhauls continued at East Hanney where six more 504Ks were stripped and rebuilt as *G-EBCK*, *'FV*, *'IN*, *'KB*, *'KR* and *'KX* prior to 1926, the year the firm moved to Witney Aerodrome, Oxford. Scarcely any part of England and Wales escaped their attention and the firm's passenger figures to the end of 1925 exceeded 32,000. Berkshire amalgamated with Northern Air Lines in May 1929 to form Northern Air Transport Ltd. with 16 aircraft, the largest 504K fleet since 1919. James Orrell, later chief test pilot of A. V. Roe and Co. Ltd. was the pilot of Northern's oldest Avro, the famous *G-EASF*, at Rochdale in 1931.

Surrey Flying Services Ltd., formed at Croydon in 1922 by A. F. Muir and W. F. Grant with two Clerget Avros, *G-EAWI* and *'WJ* (in which Capt. Muir made charter flights to Cardiff, Dublin, Brussels and the battlefields) were precursors of a large fleet of blue and silver 504Ks which became an integral part of the Croydon scene for more than a decade. Short trips were reduced to 5s., countless thousands of which were sold by the indefatigable Joe Chamberlain at the Purley Way gate. In addition to 13 for its own use the firm also reconditioned 504Ks for other companies and as late as 1934 their last serviceable machine, *G-AAAF*, was still ambling off Croydon's turf in an aroma of castor oil to return to the accompaniment of never-to-be-forgotten blips of the rotary engine and with the wheels still spinning.

The only other firm to operate on any scale was the now almost legendary Cornwall Aviation Co. Ltd. formed in September 1924 by Capt. Percival Phillips D.F.C. and F. L. Hill, garage proprietors of St. Austell. Their first machine *G-EBIZ*, resplendent in pillar box red and built by Berkshires at Witney, worked Margate beach. As business increased, other red Avros flew from fields all over the Home Counties and by 1930 the fleet consisted of *G-EBIZ*, *'NR*, *'SE*, *G-AAAF* and *'YI*. Each winter they were overhauled in the garage at St. Austell and in the spring flew out of a nearby field at Ventonwyn. Maintenance 'on location' was very difficult because the man-in-the-street who saw a partly dismantled aeroplane took it for granted that an accident had occurred. To prevent unwarranted loss of trade the Avros were taxied under a tree at nightfall and a spare engine installed secretly by means of block and tackle in the light of car headlamps. It spoke well for the superannuated 1913 design that 20 years later it could still make up to 40 take-offs a day, every day, and take the punishment involved in miles of taxying over rough ground. In the summer pilots and engineers lived a nomadic existence and flew the Avros from field to field laden with tool chests and spares, and

with bedding, tents and passenger ladders lashed to the undercarriage and between the interplane struts.

In 1932 they teamed up with Sir Alan Cobham's National Aviation Day Display but at the end of the 1933 season the Cornwall fleet disbanded to make way for Capt. Phillips' new company. At the time of his death in 1938 Capt. Phillips had carried over 91,000 passengers, nearly all of them in *G-EBIZ*.

'Cobham's Circus' succeeded in its aim of fostering airmindedness largely through the imaginative use of the red Cornwall 504Ks which enabled passengers to take part in the events. In 1933 the silver and black fleet of the North British Aviation Co. Ltd. was enlisted to enable two separate tours to take place simultaneously. Founded at Hooton in 1929 by E. E. Fresson and L. J. Rimmer with *G-EBGZ*, *'IS* and *'XA*, it normally worked Cheshire and Lancashire but in 1931 made a Lakeland tour with a base at Keswick. In 1933 L. J. Rimmer and W. 'Jock' Mackay bought up the remaining stock of the late Northern Air Transport Ltd. and the augmented fleet of 14 Avro 504Ks was used by Cobham again during the 1934 season. A series of accidents in which Mackay was killed in an Avro 504N left them with only the seemingly indestructible *G-EASF* with which to finish the 1935 season. At the end of that year the Air Ministry refused to renew Certificates of Airworthiness for rotary engined aircraft and the heyday of the Avro 504K in Britain was over.

Full details of all British Civil Avro 504Ks will be found in Appendix D.



The Dyak engined 504K c/n D.1 (later *G-AUBG*), built at Mascot by A.A.E.C. Ltd. from imported parts in 1920.

Avro 504K (overseas)

In 1919–20 the British Government made each Dominion an Imperial Gift of surplus Avro 504Ks and other aircraft, and during the next 12 years large numbers of additional 504Ks were stripped, overhauled and test flown at Croydon by the Aircraft Disposal Co. Ltd. for military and civil use overseas. Vickers Ltd. and A. V. Roe and Co. Ltd. were also heavily engaged, the latter completing 100 504Ks in 1921 alone. Manufacturing rights were also sold in Japan and elsewhere.

Australia Forty-eight Australian Flying Corps 504Ks carried *A3* serials and later served with the R.A.A.F. until replaced by D. H. Moths in June 1928. At least ten others were acquired by short lived joy-riding outfits such as Kingsford Smith's Diggers' Co-op Aviation Co. Ltd. but few made money although Norman Brearley flew 80 passengers Perth-Kalgoorlie in two machines (100 h.p. Gnome Monosoupape) in October 1919 and C. A. Butler carried 62 at Adelaide. The Australian civil register was not established until June 1921 and all flew in old Service colours.

Avro manufacturing and sales rights were vested in H. E. Broadsmith, former manager of the Manchester works, who left for Sydney with four 504Ks which had been allotted (but never carried) British marks *G-EAIV* – *'IY* in the name of the Australian Aircraft and Engineering Co. Ltd. which Broadsmith had formed in association with Capt. Nigel Love and Lt. Warneford. He also took components for 15–20 additional 504Ks. The first joyride took place at Mascot, Sydney, on January 9, 1920 after which Capt. Love used the machine for the first inter-city flight to Melbourne and a tour of the outback for a paint firm (September 7–October 18, 1920). He also won the handicap section of the first Australian Aerial Derby on November 27, 1920.

The company's second 504K (first flown as a 504L at Manly Bay, Sydney), carried several thousand joyriders at Eagle Farm, Brisbane, piloted by F. L. Roberts who on June 26, 1920 flew the first air mail 87 miles from Lismore to Tenterden. Capt. Wilson in the third Avro dropped foodstuffs to valuable sheep in flooded country, but of the three Clerget machines, only *G-EAIV*/ *G-AUCB* survived to receive civil marks in 1921. Lt. Adair delivered the fourth (110 h.p. Le Rhône) to the Queensland Northern Graziers Association at Brisbane on August 13, 1920 after a record flight of 240 miles between Newcastle and Grafton. This machine became *G-AUBE* in 1921.

Broadsmith commenced the erection of 504Ks from imported parts in 1921 and fitted some of them with Sunbeam Dyak engines. The first, *G-AUBG* for the infant QANTAS, carried 283 passengers and flew 7,400 miles in a few months, while the second, built for P. Hogarth, was delivered to Clio Station, Queensland by J. Treacy in 20 flying hours. It was eventually registered to A. J. Driver, Brisbane, as *G-AUEO* in 1924. The third and fourth, believed *G-AUCD* and *'CE* (Clerget engines), were followed by seven more Dyak 504Ks including *G-AUBS* for Percy Heyde of Nimmitabel, N.S.W., and two for inter-railhead connections of Auto Aero Services Ltd.

In 1922 A.A.E.C. received a contract for six 504Ks (Clerget) for the R.A.A.F. These were built at Mascot from selected Australian timber which proved equally strong for a weight penalty of only 80 lb. and the first, "Mary", was handed over to Bristol designer Sqn. Ldr. F. S. Barnwell at Mascot for acceptance tests on June 16, 1922. One is now preserved in the Australian War Museum, Canberra.

The 504K played a notable part in later Aerial Derby Races as in 1922 at Sydney when Dyak Avros *G-AUBJ*, *'CZ* and a third (believed *G-AUDM*) with improved Vee strut undercarriage, unbalanced rudder and triangular fin, were on the line. Capt. E. W. Percival, who had earlier fitted *G-AUDA*



The special Avro 504K with modified undercarriage and tail assembly, believed *G-AUDM*, showing the revised side cowlings of later Dyak powered machines. (*Photo courtesy of W. Boddy.*)

with a 90 h.p. R.A.F. IA, came fourth in the 1924 Derby in *G-AUEP* which had been modified to take the big 220 h.p. Hispano-Suiza engine, competing against H. C. Miller who had replaced the Dyak in *G-AUDR* by a 100 h.p. Curtiss K.6 taken from a Curtiss Seagull.

Aircraft details:

(*a*) **Imperial Gift machines**

A3–1 to *A3–48* including *A3–1* to *A3–9* (ex *H2171–H2179*); *A3–16* to *A3–19* (ex *H3033*, *'36*, *'37*, *'38*); *A3–21* to *A3–23* (ex *H3040*, *'41*, *'43*); *A3–27* to *A3–33* (ex *E3742–'46*, *'49*, *'50*); *A3–36* to *A3–41* (ex *H9835* and *'40*). Based at Point Cook, 12 with No. 1 F.T.S. and 36 in reserve at No. 1 Aircraft Depot.

(*b*) **Built by the Australian Aircraft and Engineering Co. Ltd.**

Imported aircraft: *G-EAIV–'IY*, c/n AAEC.1–AAEC.4, *'IV* became *G-AUCB* 6.21; *'IW* and *'IX* flown without marks, one crashed at Goulburn, N.S.W.; *'IY* became *G-AUBE* 6.21.

Erected from imported components: (Clerget) *G-AUCD* and *'CE*, c/n AAEC.5 and AAEC.6. (Dyak) *G-AUBG*, c/n D.1, QANTAS, converted to Avro 548A; *G-AUEO*, c/n D.2, P. Hogarth; *G-AUBJ*, c/n D.5, Chapman Aerial Services, Sydney; *G-AUBS*, c/n D.6, P. Hyde; *G-AUCZ*, c/n D.7, A. G. McKeahnie, crashed at Smeaton, Victoria 9.6.30; *G-AUDM*, c/n given as 1000DC but believed D.8 with modified tail, A. D. Reid, Taree, N.S.W.; *G-AUDR*, c/n D.9, M. Cox, Mascot, temporarily with Curtiss K.6 in 1924.

Built from Australian materials: *A3–49* to *A3–54*.

(*c*) **Other Civil Avro 504Ks**

G-AUBA/H2030, G. M. Elwyn, Inglewood, Q.; *G-AUBL/D6396* and *G-AUBM/H2846*, the Orva Commercial Aviation Co.; *G-AUBP*, J. Austin, Mudgee, N.S.W.; *G-AUBQ*, Diggers' Co-op Aviation Co., crashed at Cowra, N.S.W. 18.7.21; *G-AUBR/H1909*, Diggers', crashed at Wagga, N.S.W. 19.9.21; *G-AUCG*, Butler-Kauper Aviation Co., crashed at Minalaton, S.A. 10.1.22; *G-AUCI/H1973*, re-registered to F. J. Barnes 1924 as *G-AUEN* burned out at Perth, W.A. 27.10.26; *G-AUCJ/E3432*, Geelong Air Service; *G-AUCL*, West Australian Airways Ltd.; *G-AUCN*, Mildura Aircraft Ltd., crashed at Mildura, V. 10.2.22; *G-AUCY/H7499*, Macpherson and Farmer, Melbourne, crashed 4.11.25; *G-AUDA/D5512*, Aero Flight Aviation Co., Brisbane, burned out 20.11.24; *G-AUDQ/E3501* ex *G-EAEC*, A. W. Vigers, wrecked by gale, Melbourne 5.23; *G-AUEC/H1960*, L. H. Holden, Sydney; *G-AUEP*, E. W. Percival, to Airgold Ltd., burned out at Lae, N.G. 6.6.28; *G-AUEW*, D. G. Brim and Sons, Milton, N.S.W.; *G-AUFP/E3363*, Larkin Aircraft Supply Co., crashed at Wallacedale, V. 3.1.27; *G-AUGP*, Larkin Aircraft Supply Co. "Pilot Bird", crashed at Melbourne, V. 21.3.30.

Belgium Demonstrations at Brussels in August 1920 by Avro 504Ks *G-EAHX* and *'VD* led to the placing of Contract 45/21 with Vickers Ltd. in 1921 for 12 machines to re-equip the 8th (Flying School) Group of l'Aeronautique Militaire. The order was made up of six converted by A. V. Roe and Co. Ltd. at Hamble and flown out with Belgian civil marks, and six redundant Avro Transport Company machines originally converted for joyriding in 1919. A further 38 obtained from the Aircraft Disposal Co. Ltd. in 1922 included 18 flown from Croydon to Brussels in British civil marks November 1921–July 1922. One other, *O-BADB*, was flown out by A. H. Forson for the pioneer airline SNETA on March 24, 1921.

Further needs were met by the construction of 27 Avro 504Ks (80 h.p. Gnome or 130 h.p. Clerget) under licence at Evere by SABCA. *A-51*, first of these, was specially equipped and flew inverted for 2 min. 27 sec. piloted by G. F. van Damme of the Belgian Army Flying School, Wevelghem. Twelve outdated SABCA 504Ks were sold for civil purposes 1934-38.

Aircraft details:

(*a*) **Purchased in the United Kingdom**

Belgian Air Force serials *A-1* to *A-50* included six prepared by A. V. Roe and Co. Ltd., Hamble c/n 5011–5016, Cs. of A.* issued 22.4.21, flown out as *O-BADG* to *'DH* and *O-BADK* to *'DM*; former Avro Transport Company machines *G-EABP*, *'DM*, *'DN*, *'IH*, *J749/G-EAND* and *J753/G-EANG* delivered 6.21; and the following overhauled by the Aircraft Disposal Co. Ltd. and flown out by Capts. Hayns, M. Pearcy, E. L. Foote, A. F. Muir, R. H. Stocken and F. T. Courtney: *G-EAZF/H7426*, *'ZG/H6605*, *'ZK/H6611*, *'ZL/H6601*, *'ZQ/H2516*, *'ZR/H2553*, *'ZS/H2558*, *'ZU/H2509*, *'ZV/H2565*, *G-EBAF/H7467*, *'BP/H6653*, *'CC/H6656*, *'CD/H7487*, *'CF/H2065*, *'CO/H7482*, *'CR/H7474*, *'CS/H2062*, *'CT/H2071*, *'DC/H2060*, *'DJ/H2052*. *G-EAZF* and *ZL* crashed on test at Croydon and were replaced.

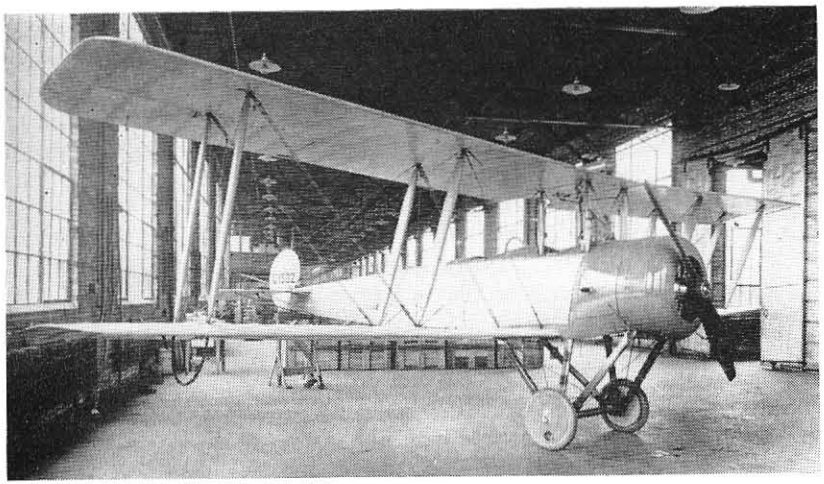
*Used throughout to indicate 'Certificate of Airworthiness'.

(*b*) **Built by SABCA**

Belgian Air Force serials *A-51* to *A-77*, twelve of which were civilianised 1934–38 as *OO-ANS*, *'NW*, *'NY*, *'PA*, *'PB*, *'PD*, *'PE*, *'PK*, *'PL*, *'PN*, *'PX* and *'PY*.

Canada In 1918 a contract placed with Canadian Aeroplanes Ltd., Toronto for 100 Avro 504Ks (130 h.p. Clerget) was ended by the Armistice when only two had been completed. Their Vee-type undercarriages had a third bracing strut and differed considerably from the British original.

After the war Canada received 63 Imperial Gift 504Ks which, from August 6, 1920, were used in lettered markings at Camp Borden, Ontario, for pilots' refresher courses. Some were employed by the Air Board for forestry patrol or aerial photography, *G-CYAC* making the first Canadian Air Force survey of Ottawa. Survivors of the 49 Avro 504Ks at Camp Borden at the beginning of 1922 were reconditioned by the Laurentide Air Service, Quebec,



C1502, second of the two Avro 504Ks built at Toronto by Canadian Aeroplanes Ltd. and incorporating a third undercarriage strut. (*Canadian National Aviation Museum Photo.*)

in 1924 and others were reworked by Canadian Vickers Ltd., some as Avro 504Ns.

Seven 504Ks (110 h.p. Le Rhône) were imported privately by the Canadian Aircraft Co. Ltd. of St. Charles, Winnipeg, for conversion to 3 seaters for joyriding. One of these, *G-CAAE*, came from the London Flying Club, Hendon; and *G-CAAR* made a 400 mile electioneering trip through Manitoba during 1920. On October 15–16, 1920 H. Dougall and F. H. Ellis flew *G-CABV* 487 miles from Winnipeg to The Pas, Manitoba, the longest commercial trip in Canada up to that time. Christened "Thunderbird" by the Cree Indians, *'BV* was the first aircraft to fly north of latitude 53 degrees.

Aircraft details:

(*a*) **Built by Canadian Aeroplanes Ltd., Toronto**

C.1501 and *C.1502* completed 10.18 and 11.18 respectively.

(*b*) **Imperial Gift aircraft registered to the Canadian Air Force (later the R.C.A.F.)**

E361–E363/*G-CYEE**, *'AC*, *'AI*; *H1917*/*G-CYAL*; *H2041–H2049*/*G-CYAX**, untraced (1), *G-CYAP*, *'AS**, *'DA**, *'CY*, *'FI*, *'AQ*, *'CX*; *H7461–H7462*/*G-CYAR*, *'FE*; *H9552–H9558*/untraced (1), *G-CYFJ*, untraced (1), *G-CYFG*, *'FO*, untraced (1), *G-CYFF*; *H9621–H9633*/*G-CYCS*, *'AA*, untraced (1), *G-CYBH*, *'BL*, *'AV*, *'AT*, *'AW*, *'AU*, *'CZ*, *'FM*, *'FN*, untraced (1); *H9665–H9666*/*G-CYCU*, *'EI*; *H9668–H9672*/*G-CYCT*, *'CD*, *'BM*, *'CR*, *'BG*; *H9690*/*G-CYCA*; *H9714–H9715*/*G-CYCH*, *'BK*; *H9717*/*G-CYCK*; *H9722*/*G-CYFH*; *H9727*/*G-CYEH*; *H9729*/*G-CYEG**, *H9732*/*G-CYCJ*; *H9735–H9745*/*G-CYFL*, *'CI*, *'CB*, *'AM*, *'CL*, *'BS*, *'CM*, *'BZ*, *'FK*, *'BD*, *'BR*; *H9749* and *H9755*/untraced (2).

Note: (i) Avro 504L seaplanes are marked with an asterisk. (ii) Two of the untraced aircraft were registered *G-CYHA* and *'HD*. (iii) *G-CYAM*, *'AU*, *'AV*, *'CM* and *'CZ* were allotted constructor's numbers C.V.16, 15, 19 17 and 18 after reconstruction by Canadian Vickers Ltd. (iv) *G-CYAQ* and *'CX* later rebuilt as Avro 504N. (v) *G-CYAQ* and *'CM* later allotted R.C.A.F. serials *2* and *13*. (vi) *G-CYBH* crashed 22.10.25.

(*c*) **Avro 504Ks imported 1920 for commercial use**

G-CAAE/*D6202*, ex *G-EABO*, Canadian Aerial Services, Montreal, crashed at St. Louis, P.Q., 22.5.22; *G-CAAQ*/*H2292*, Canadian Aircraft Co. Ltd., Winnipeg, to W. P. A. Straith, Winnipeg, after accident 19.8.23 believed rebuilt (see page 165); *G-CAAR*/*D9076*, Canadian Aircraft Co. Ltd., Winnipeg, crashed at Fort Frances, Ontario, 26.8.20; *G-CABD*/*D8842*, Bishop-Barker Aeroplanes Ltd., Toronto, flown as *D8842*, s.o.r.* 7.24; *G-CABP*, Edmonton Aircraft Ltd., s.o.r. 1.21; *G-CABS*/*D8997*, A. E. Bingham, Winnipeg, flown as *D8997*, crashed on test 16.7.20, rebuilt as Avro 548 *G-CACI*; *G-CABV*/*F9738*, Canadian Aircraft Co. Ltd., Winnipeg, s.o.r. 7.24.

*Used throughout to indicate 'struck off register'.

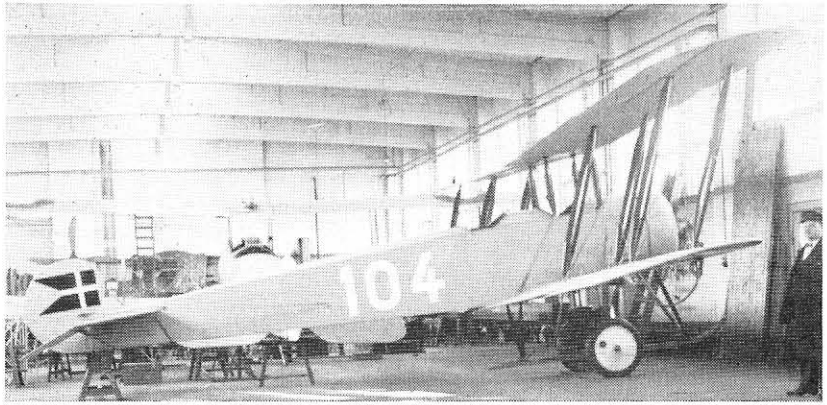
China Twenty Avro 504Ks ordered by the Chinese Government from Vickers Ltd. on August 12, 1919 were mainly unused Harland and Wolff-built machines, 18 of which were exported with British Certificates of Airworthiness dated March 10, 1920 and two others as instructional airframes or spares. First deliveries, which reached China in July 1920, were used at the Nanyuan Training School, Peking, but a number were seized by local warlords and only a few remained in Government hands at Tsing Ho in 1923.

Aircraft details:

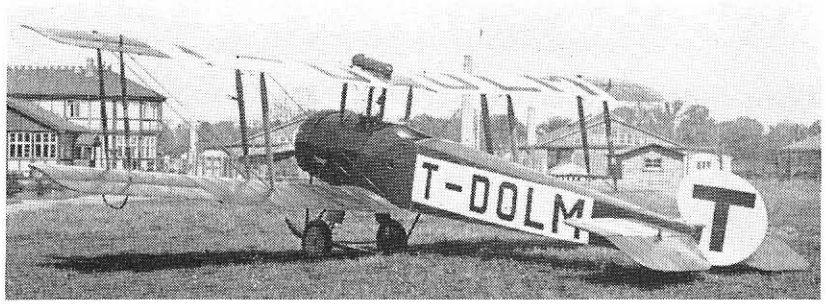
E366, *368*, *370*, *373*, *376*, *377*, *379*, *380*, *393*, *397*, *400*, *409*, *421*; *E9484*, *9486*, *9489*; *E9504*; *H9579*; and two others.

Denmark Six Avro 504Ks bought from the Aircraft Disposal Co. Ltd. by the Danish Navy, arrived at Copenhagen by sea on December 29, 1920 and were erected at the Naval Flying School, Avedøre. They moved to Kastrup in 1923 and to Ringsted in 1926 where two survived for conversion into 504Ns in 1928.

Det Danske Luftfartselskab (D.D.L.) obtained three 3 seat 504Ks from the same source for joyriding in 1919. Two of them, *H2549* and *H2556* (110 h.p. Le Rhône), already certificated in England as *G-EAJE* and *'JF* to D.D.L. pilot Capt. J. D. Atkinson, reached Copenhagen by sea on August 8, 1919 but the third (unregistered) was shipped from Leith to Iceland in charge of Capt. C. Faber who began pleasure flying at Reykjavik on September 3. Operated by Flugfélag Islands (not the later company of that name), the machine made a landing at the remote Westmann Islands and carried 140



Danish Navy Avro 504K *H2023/104* at Kastrup in 1923. (*Photo courtesy of H. Kofoed.*)



Det Danske Luftfartselskab's first Avro 504K *G-EAJE* in Danish marks as *T-DOLM* in 1921. (*Royal Danish Air Force Photo.*)

passengers in three weeks. Faber then returned to Denmark and F. Frederick-sen used the Avro for fishery patrol in 1920.

Only the first of Atkinson's machines, which had been re-engined with a 150 h.p. Bentley B.R.1, received a Danish civil registration but when joy-riding petered out in 1921 both were acquired by the Danish Army which also took over the repatriated Icelandic machine in June 1922.

Aircraft Details:

(*a*) **Danish Navy**

H2217/Danish Navy *101*, flew 94 hr. 39 min., crashed at Kastrup 28.8.23; *H2472/102*, crashed at Kastrup 5.5.25; *H2021/103*, flew 150 hr. 3 min., crashed at Kastrup 13.8.23; *H2023/104*, flew 187 hr. 0 min., converted to 504N serial *112* in 1928; *H2430/105*, flew 197 hr. 30 min., to spares 19.1.28; *H2027/106*, flew 110 hr. 25 min., converted to 504N serial *111* in 1928.

Note: (i) British Cs. of A. issued to all six 16.11.20. (ii) *H2430* replaced *H2256* destroyed during engine run at Croydon 24.11.20.

(*b*) **Det Danske Luftfartselskab**

G-EAJE/H2549, C. of A. 1.8.19, re-registered 1921 as *T-DOLM*, to the Danish Army 12.11.21 as 'Avro 2', crashed at Kløvermarken 11.4.22; *G-EAJF/H2556*, C. of A. 1.8.19, to the Danish Army 12.11.21 as 'Avro 1', crashed at Kløvermarken 24.6.22; *H2545*, 110 h.p. Le Rhône, Flugfélag Islands, to the Danish Army with Bentley B.R.1 as 'Avro 3' 6.22, s.o.c.* 1.31.

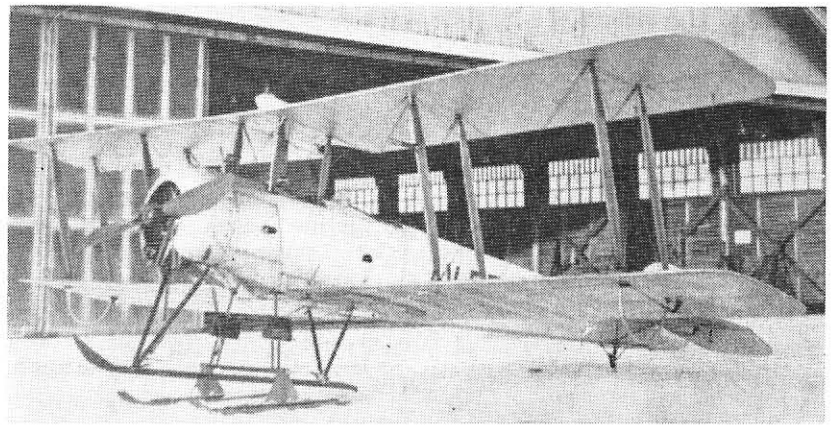
*Used throughout to indicate 'struck off charge'.

(*c*) **Danish Army**

Serials 'Avro 1' and 'Avro 2' used again for replacements obtained from A. V. Roe and Co. Ltd. without engines and fitted in Denmark with Bentley B.R.1s. Test flown at Kløvermarken 8.23 and 7.23 respectively, s.o.c. 1.31.

Estonia Aeronaut A.S. inaugurated an airmail service between Reval, Estonia and Helsingfors, Finland, with Avro 504Ks (130 h.p. Clerget) on February 7, 1920. Landings were made in the ice-bound harbours by British pilots Emery and Swatridge. At least seven 504Ks (130 h.p. Clerget) were acquired by the Estonian Air Force in 1921, serials *15–21*.

Finland One Avro 504K *G-EBNU/E448* was supplied by the Aircraft Disposal Co. Ltd. to Finnish Air Force in 1926. It was issued with a British C. of A. on April 23 of that year and flew in Finland with a ski undercarriage. It is the well-known machine *AV-57* stored in the Finnish Air Force Museum at Vesivehmaa, Finland.



The Finnish Air Force ski-equipped Avro 504K *AV-57* was supplied by the Aircraft Disposal Co. Ltd. in 1926 as *G-EBNU* (visible under lower mainplane).

India The Imperial Gift of 100 aircraft for India included 18 presented to the Indian States. Many were Avro 504Ks, surplus examples of which were returned to the Public Works Dept., Aviation Branch, and then given to individuals attempting to open up commercial aviation in India. Their subsequent activities are obscure and none appeared in the register of Indian civil aircraft.

Ireland In 1921 the Irish Air Corps purchased five Avro 504Ks from the Aircraft Disposal Co. Ltd. and one from the Central Aircraft Co. Ltd., Northolt, for reconnaissance, leaflet dropping and train escorting. They afterwards formed the equipment of 'A' Flight of the flying school at Baldonnel.

Joyriding by civil 504Ks occurred only in 1932 when two aircraft bought from Northern Air Transport Ltd., Manchester, were operated on a roving basis by Irish Air Lines of Waterford.

Aircraft details:

(*a*) **Irish Air Corps**

H2073, *H2074*, *H2075*, *H2505* and one other; *D7588*/*G-EADQ*.

(*b*) **Irish Air Lines, Waterford**

EI-AAM ex *H9833*/*G-AAYH*; *EI-AAN* ex *J8371*/*G-ABHP*; both withdrawn from use 1932.

Japan A British mission to the Imperial Japanese Navy in April 1921 led by the Master of Sempill, took with it 20 Avro 504Ks. On arrival, one serialled *108* was displayed at the Yoyogi parade ground, Tokyo, to publicise the opening of a waterside training base at Kasumigaura also suitable for Avro 504L seaplanes. In the same year A. V. Roe and Co. Ltd. sold 504K manufacturing rights to Japan for £30,000 as well as 48 complete aircraft to the Japanese Army, including eight redundant 1919 joyriding conversions. Japanese 504Ks were built by the Nakajima Hikoki Seisaku Sho (Nakajima Aircraft Manufacturing Co.) at Ohta-Machi, Tokyo, and fitted initially with 150 h.p. Bentley B.R.1 engines. As these wore out they were replaced by 110 h.p. Le Rhônes built under licence by the Tokyo Gasa Denki (Tokyo Gas and Electric Industry Co.) Over 75 flew in civil markings alone, at least three were still active in 1928, and in 1934 a solitary example was still used by Nihon Koku Kabushiki Kaisha (Japan Air Transport Co.), Tokyo.

Aircraft details:

(*a*) **From A. V. Roe and Co. Ltd.**

J754/*G-EANP*; *J757*–*J763*/*G-EANX* to *'OD*; at least *J-BAXG* and *J-TEEJ*, Avro (Hamble) c/n 5030 and 5044.

(*b*) **Nakajima-built 504Ks**

J-BAAK, *'AP*, *'BD*, *'BM*, *'BP*, *'CA*, *'CB*, *'CD*, *'DG*, *'ED*, *'EH*, *'FD*, *'FL*, *'GA*, *'GL*, *'HD*, *'HI*, *'IH*, *'JH*, *'KD*, *'LA*, *'MD*, *'OD*, *'OL*, *'PD*, *'QG*, *'QH*, *'RB*, *'RD*, *'SF*, *'TB*, *'TY*, *'VB*, *'VF*, *'WD*, *'XB*, *'XL*, *'YD*, *'ZD*; *J-BBUD*, *'YB*; *J-BCAD*, *'EE*, *'EF*, *'EG*, *'FO*; *J-BDAB*, *'YB*; *J-BEAB*, *'FD*, *'MB*, *'YB*; *J-BFIB*; *J-TACG*, *'GK*, *'VY*; *J-TEEH*, *'FI*, *'IN*, *'TZ*; *J-TIHN*, *'IO*, *'JP*, *'MS*, *'NT*, *'QW*, *'VB*, *'YE*, *'ZE*; *J-TOOT*, *'PU*; *J-TUEL*, *'SZ*, *'UB*.

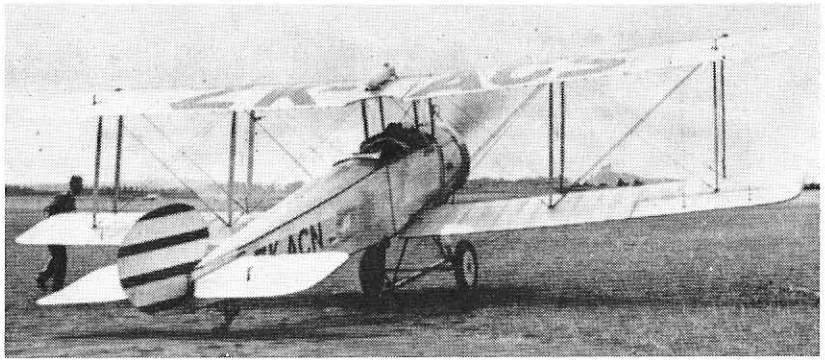
Malaya One Avro 504K was shipped to Penang in 1920 for a Chinese, Tsoe K. Wong, who had built and flown biplanes of his own design at Shoreham 1913–14. The 504K stalled on a climbing turn on its first take-off and the pilot L. J. Pugh, late of the Avro Transport Company, Southport Sands, was killed.

Netherlands Indies Thirty-six Avro 504Ks (110 h.p. Le Rhône) delivered to the Netherlands Indies Army Air Arm 1919–22 were supplemented by others built in the Air Arm's own workshops. Those bought in the U.K. were delivered by Vickers Ltd. in three batches of 12, to Contract 269/19 on May 31, 1919; to 453/19 on December 18, 1919; and to 640/22 on November 8, 1922. They were stationed at Kali Dvatch and bore serials commencing *A-101*.

New Zealand Only two of the 20 Imperial Gift Avro 504Ks accepted by New Zealand in 1920 were used for military training. They were based at Sockburn, Christchurch and the rest distributed on loan to the Canterbury Aviation Company, Sockburn; the New Zealand Flying School, Auckland; and the New Zealand Aero Transport Company, Timaru. A few of these eventually received civil marks.

Four 504Ks (*D6243*, *E4153*, *E4237*, *E4242*) had been bought earlier from the Disposal Board in England by Capt. Euan Dickson of the Canterbury Aviation Company. These arrived by sea on January 14, 1920 and *E4237* was flown Sockburn–Fairlie–Mt. Cook with two passengers on May 21, by Capt. Dickson who also made the first flight across the Cook Strait while en route Sockburn–Trentham, Wellington in *D6243* on August 26. The company's fleet rose to eleven 504Ks when seven others were loaned by the Government. On December 23, 1921 *E9432* "High Jinks" was flown by Capt. L. Brake via Napier to Gisborne where pleasure flights were made from Waikanae Beach.

The New Zealand Flying School converted four of its six 504Ks into 3 seaters and two to 504Ls. Capt. R. Russell flew one from Auckland to Wanganui and continued in *F9745* to New Plymouth on October 5, 1920. There it spun in from 200 ft. on November 9, the local mayor, pilot and another passenger being killed. The New Zealand Aero Transport Company also received six 504Ks including *E9429* which made a pioneer flight from Wellington to Nelson on November 11, 1921 piloted by Capt. Fowler. Another of the firm's pilots, Capt. M. W. Buckley, acquired *H5241* and named



201, first of the 1929 N.Z.P.A.F. Avro 504Ks, after being converted to *ZK-ACN* in 1934 and repaired with the wings of *206*/*ZK-ACS*. (*Photo courtesy of C. Longworth-Dames.*)

it "Blazing Arrow". Trading as the Arrow Aviation Company he undertook joy flying at the 1923 Hokitika Exhibition, and made the first photographic flights over the Franz Josef Glacier. Leaving Greymouth on June 4, 1924, he also made the first flight from Westland to Canterbury, crossing between Mt. Rolleston and Mt. Frankton at 7,500 ft. and covering the 128 miles to Wigram in $1\frac{3}{4}$ hours.

In 1923 the New Zealand Government formed an air arm by purchasing the assets of the Canterbury Aviation Company together with Sockburn Aerodrome which it renamed Wigram. Initial equipment included the two 504Ks used for military training since 1920 and the Canterbury machines, all of which reverted to unprefixed military serials. Many served later with the N.Z. Permanent Air Force for which six replacement aircraft were erected locally in 1925.

Aircraft details:

(*a*) **Purchased in the U.K. by the Canterbury Aviation Company 7.19**

D6243, *E4153*, *E4237*, *E4242*.

(*b*) **Imperial Gift aircraft**

E3137, *'42*, *E9424*, *'27*, *'29*, *'32*, *F9745*, *H1952*, *'58*, *'64*, *'66*, *'68*, *'70*, *H2986–H2990*, *H5240*, *'41*.

(*c*) **Imperial Gift aircraft loaned to civil operators**

New Zealand Flying School: *F9745* (crashed at New Plymouth 9.11.20), *H2986* (see 504L), *H2988*, *H2989*/*G-NZAA*, *H5240*/*G-NZAB* (to the Aerial Transport Co., Hastings), *H2990*/*G-NZAC* (see 504L). Canterbury Aviation Company: *E3137* (crashed at Wigram 1.25), *H1952*, *'58*, *'70*, *E9432*/*G-NZAF* "High Jinks", *H1964*/*G-NZAG* (crashed near Wigram

17.2.24), *H2987*/*G-NZAJ*, *E4242*/*G-NZAK*. New Zealand Aero Transport Company: *E9429* (crashed at Hawe 2.22), *H1966*/*G-NZAL*, *E3142*/*G-NZAN*, *H5241*/*G-NZAO* (to M. W. Buckley 1923 as "Blazing Arrow"), *E9424*/*G-NZAP*, *E9427*/*G-NZAR* (cabin conversion, crashed 6.1.22).

(*d*) **Avro 504Ks erected at Wigram for the N.Z.P.A.F. 1929**

N.Z.P.A.F. serial *201*, c/n A.201, first flown 1.9.25; to L. Brake and J. Paul 1934 as *ZK-ACN*; *202*, c/n A.202, to F. C. Norton 1934 as *ZK-ACU*, burned out 1936; *203*, c/n A.203, to Claridge, Wilcombe and Atkinson 1934 as *ZK-ACT*, to R. D. Downey, scrapped 1937; *204* and *205*, c/n A.204 and A.205, were written off at Wigram; *206*, c/n A.206, to J. Paul 1934 as *ZK-ACS*, to P. H. Wilton, scrapped 1938.

Norway Two ex R.F.C. 504As (80 h.p. Le Rhône) erected at Kjeller by the Norwegian Army Air Force on February 14, 1918 were allotted serials *F-1* and *F-7* (later changed to *101* and *103*). The former crashed at Kjeller on September 30 and was rebuilt with a 90 h.p. Thulin (Swedish-built Le Rhône). The Army then acquired three Avro 504Ks in England. Two with 100 h.p. Sunbeam Dyak engines which arrived at Kjeller on November 2, 1920 were commissioned in July 1921 as *103* (reallocation) and *105*. The third 504K (110 h.p. Le Rhône) was presented by explorer Roald Amundsen but crashed on its first test flight on June 30, 1922 both occupants being killed.

The first civil flying school was started at Gardermoen in the summer of 1919 by Norsk Aeroplanfabrikk A.S. with one unregistered Avro 504J (100 h.p. Gnome Monosoupape), and at least one other 504A was also imported. Intended for naval training, the identity of the latter has not survived but after storage at Tønsberg 1919–26 it was fitted with a 140 h.p. Hispano-Suiza HS 8Aa watercooled engine for the firm's proprietor Lt. Christian Hellesen. Registered *N-5*, its end came swiftly and Hellesen then acquired two 504Ks one being *101*, the original Norwegian Army 504A. Both were rebuilt with Hispano engines and were registered *N-29* and *N-37* respectively, the latter having enclosed cockpits and ski undercarriage.

Aircraft details:

(*a*) **Norwegian Army Air Force**

Avro 504A, *101* ex *F-1* ex *B4305*, rebuilt with 90 h.p. Thulin, sold to Lt. C. Hellesen; Avro 504A, *103* ex *F-7* ex *B4306*, crashed at Kjeller 1.4.19; Avro 504K, *103* (second use of serial), Dyak engine; Avro 504K, *105*, Dyak engine, crashed at Kjeller 29.10.23; Avro 504K, *107*, Le Rhône engine, crashed at Kjeller 30.6.22.

(*b*) **Civil aircraft (Hellesen Hispano conversions)**

N-5, ex *101*, Norwegian C. of A. issued 9.4.27, crashed at Geilo 13.4.27; *N-29*, believed Canadian-built, converted 1929, marks re-issued to Klemm L.20 in 1933; *N-37*, converted 1929, sold 19.2.29 to J. Strandrud, s.o.r. 7.31.



N-37, the Avro 504K fitted with 140 h.p. Hispano-Suiza HS 8Aa and cabin top for Lt. Christian Hellesen in 1929. (*Photo courtesy of O. G. Nordbø.*)

Portugal Thirty Avro 504Ks (110 h.p. Le Rhône) ordered by the Portuguese Government from Vickers Ltd. under Contract C.1113/23 dated November 10, 1923 were entirely reconditioned at the Manchester works of A. V. Roe and Co. Ltd. and allotted constructor's numbers accordingly. Bearing serials *1–30*, they were all delivered in Portugal by May 20, 1924 and many were still in use at the Cintra flying school in 1927 and four were flying with the Grupo de Esquadrilhas de Aviação "Republica" as late as 1934.

Aircraft details:

Serials *1–10*, British Cs. of A. issued 15.5.24, c/n R3/LE/12065, '84, '82, 12167, 12099, 12150, 12235, '01, 12320, 12218; serials *11–30*, British Cs. of A. issued 17.5.24, c/n R3/LE/12116, '33, 12286, '69, 12303, 12252, 12337, '54, '71, '88, 12405, '22, '39, 12541, 12473, '90, 12507, '24, 12456, 12558.

South Africa Imperial Gift 504Ks formed the equipment of S.A.A.F. training, photographic and artillery spotting units until replaced by Avro 504Ns in 1927. For pleasure and charter flying three Le Rhône engined three seaters were shipped to Johannesburg in July 1919. These had been allotted British marks *G-EAFU*, *'FV* and *'FW* in the name of the South African Aerial Transport Company, sole Avro agents for the territory. Named "The Rand Queen", "Natalia" and "Orangia" at Baragwanath Aerodrome on October 25 and piloted by Maj. A. M. Miller, Capt. Ross and Capt. Rutherford, they penetrated to all parts of the Union. Rutherford gave pleasure flights in the Northern Transvaal to former Boer War leaders Gen. T. E. Botha and Capt. de Jager, while Miller made a long

distance flight to Kimberley and on November 15 flew to Durban for the *Johannesburg Star*, dropping 1,200 copies of the newspaper en route. One of two additional machines acquired in December 1919 was flown by Rutherford to Bulawayo where it was named "Rhodesia" in June 1920 and twice filmed the Victoria Falls. One Avro hired by the Union Air Force made unsuccessful rain making experiments on October 5, 1920 by dropping sand on clouds at a height of 5,000 ft.

Although "Natalia" had rescued the crew of Handley Page 0/7 *G-EANV* when it crashed at Beaufort West on February 23, 1920 and over 5,000 passengers had been carried in 15 months, the company was wound up and surviving Avros "Natalia", "Griqua" and "Rhodesia" auctioned. Two continued operations with former S.A.A.T. pilots of the Ross-Thompson Aviation Company and on March 24, 1921 Maj. Honnett established a South African commercial height record by flying one of them over the Drakensberg Range with two passengers and luggage. The third crashed on take-off from Baragwanath on December 15, 1920 killing purchaser S. Brick, wife and pilot F. V. Preller. Ross-Thompson 504Ks barnstormed for 18 months before sale in Southern Rhodesia where one crashed at Rusapi through elevator control failure in 1921.

Aircraft details:

(*a*) **Imperial Gift aircraft**

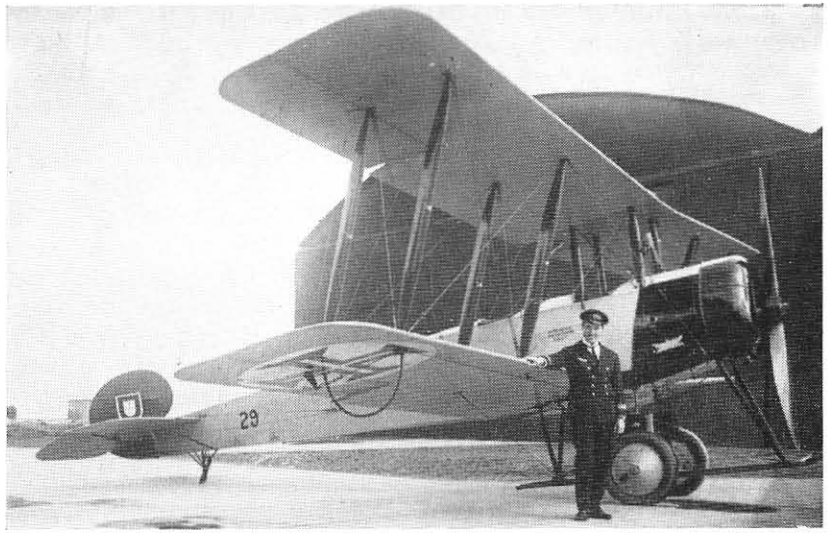
Surplus R.A.F. Avro 504Ks re-serialled from *401* to at least *414*.

(*b*) **South African Aerial Transport Company**

G-EAFU/H2583, *G-EAFV/H2584*, *G-EAFW/H2591*, British Cs. of A. issued 10.7.19. They were named "The Rand Queen", "Natalia" and "Orangia" but the order is uncertain. Two others, "Rhodesia" and "Griqua" were bought 12.19. One crashed at Baragwanath 15.10.21, one at Rusapi, Southern Rhodesia 1921.

South America Argentina accepted the gift of one Avro 504K from the Aircraft Disposal Co. Ltd. in 1921 and purchased eight more on condition that the firm supplied an instructor for the flying school at El Palomar. A tenth 504K (110 h.p. Le Rhône) was used by the Tucuman Civil Aviation School under Capt. S. H. Holland, but this was written off at Lules in April 1920.

Four Avro 504Ks (100 h.p. Gnome Monosoupape, 110 h.p. Le Rhône or 130 h.p. Clerget engines) bought in England for the Brazilian Naval Air Service were joined by eight others in 1921. Ten reconditioned machines (110 h.p. Le Rhône) supplied to the Chilean Government by A. V. Roe and Co. Ltd. in 1921 were used by the Military Aviation Service flying school at Lo Espejo and included at least two unused Avro Transport Company civil conversions and one aircraft, serial *82*, named "Curico". The Guatemalan Air Force purchased a number of Avro 504Ks in 1924 and the type



The Avro 504K *29* at Manchester prior to delivery to the Portuguese Government in May 1925.

was used by the Mexican Air Force at the Balbuena Flying School 1922–30.

The Peruvian Ministry of War placed a third and final order with Vickers Ltd. on March 13, 1922 for four Avro 504K trainers to Contract C.137/22/160, delivery of which was completed on August 3, 1922. They were erected on Lima Racecourse and flown to the training base at Las Palmas. These and machines from two earlier batches of four in 1920–21 to Contracts 275/20 and 34/21 were still used for training by the Peruvian Navy in 1925. Four Avro 504Ks were in use by the Uruguayan Air Force at San Fernando Aerodrome, Montevideo, in 1920.

Aircraft details:

Argentina: *E9428*, *'30*, *H1913*, *H2024*, *'26*, *H6603*, *H7422*, *'92*, *'97*, British Cs. of A. issued 25.4.21. Brazil: No information. Chile: *G-EAMO*/*J746*, *G-EANE*/*J751*, and eight others. Guatemala: No information. Mexico: At least *E9441*. Peru: *E372*, *391*, *395*, *399*, British Cs. of A. issued 1.3.20, and eight others. Uruguay: No information.

Spain One Avro 504K overhauled at Hamble by A. V. Roe and Co. Ltd. was flown to Spain in August 1919 by Capt. Truelove, had red mainplanes and yellow fuselage, and was maintained by the Air Force for the personal use of King Alphonso. Additional machines were delivered to military flying schools in 1923 and one civilianised as *M-AIAI* in June 1924. Four sold to the Spanish Royal Naval Air Service by the Aircraft Disposal Co. Ltd. in 1925, were based at Barcelona.

Aircraft details:

E434, *445*, *450*, *H2057* to the Spanish Royal Naval Air Service with British Cs. of A. issued 30.6.25.

Sweden The first two Swedish Avro 504Ks (110 h.p. Le Rhône), *E3115* and *H1955*, were imported by the P.O. Flygkompani which operated from Barkaby and bore the initials of founder Lt. Per Oscar Herrström who employed several British pilots including G. L. P. Henderson and A. B. Youell. Although surveyed by the Swedish authorities on July 11, 1919 and allotted civil marks *S-AAC* and *'AD*, they flew with R.A.F. serials and the letter S on the fuselage, and visited many provincial cities, taking off from deep snow in 25 degrees of frost. Engines were warmed for starting by a lighted blowlamp placed in the engine bay. On June 2, 1920 a few experimental Stockholm–Helsingfors flights were made. An anonymous 504K (130 h.p. Clerget), flown out by Capt. Saunders in October 1919, was not approved at survey on December 18 and not used. One machine flown temporarily as a seaplane and three others used in North Sweden in 1921 are discussed in the Avro 504L chapter.

Two 504Ks (130 h.p. Clerget) ordered from A. V. Roe and Co. Ltd. by the Swedish Navy on October 27, 1923 were shipped from Hull on January 18, 1924. Numbered *6* and *7* (*6* on skis) they were joined later by three others (believed *8*, *9* and *10*) ordered on September 22, 1924. After the formation of Flygvapnet in 1926 they were renumbered *064* and *072–075* under the designation Sk 3. When *074* was struck off charge on June 30, 1928 it was auctioned at the Ljungbyhed Flying School and almost certainly became civil as *S-AABT* two weeks later.

Aircraft details:

(*a*) **Civil**

S-AAC/*E3115* and *S-AAD*/*H1955*, Swedish Cs. of A. issued 11.7.19, P.O. Flygkompani; *S-AABT*, c/n R/R3/CL/10688, believed ex *074*, Swedish C. of A. 21.8.28 to S. J. Mansson, Gothenburg, last owner T. C. J. Wahrgren, Gällivare, crashed 14.5.31 as *SE-ABT*; *SE-ACC*, c/n given as 2289/5652, Swedish C. of A. 30.10.29, ex Flygvapnet, T. C. J. Wahrgren, Gällivare, last owner F. A. Oberg, Hudiksvall 5.31.

(*b*) **Military**

Swedish Navy *6–10* became Flygvapnet *064* and *072–075* in 1926, s.o.c. 9.9.27, 25.11.27 (crashed near Ljungbyhed 17.11.27), 30.6.28, 30.6.28, 13.3.28 and 12.4.28 respectively.

Switzerland Avro 504Ks *G-EAKR* and *'KV* (130 h.p. Clerget), overhauled by A. V. Roe and Co. Ltd. at Alexandra Park in August 1919 for the Swiss Aero Club, were ferried via Hounslow on September 17, 1919 by Capts. E. Bradley and H. M. Goode. *G-EAKV* arrived at

Lausanne three days later via Paris, Dijon and the Jura Mountains, but *'KR* was damaged beyond repair in a forced landing at Les Laumes-Alèsia in the Côte-d'Or on September 20. *G-EAKV* crashed while avoiding high tension cables while joyriding at Nyon on November 2 but was rebuilt for the Lausanne Aéro École d'Aviation. The school erected a second Avro (110 h.p. Le Rhône) from spares which first flew on February 21, 1920 piloted by Bradley.

Aircraft details:

G-EAKR/E4246, C. of A. issued 19.9.19, forced landed in the Côte-d'Or 20.9.19; *G-EAKV/J803*, C. of A. issued 17.9.19, to the Lausanne Flying School as *CH-10*, written off 1921; *CH-39* built from spares at Lausanne 1920, crashed at Blecherette 3.6.22.

United States Flights over Washington by Col. C. F. Lee in Avro 504J *C4312* during 1917 were followed by inspection by the Dayton-Wright Airplane Company at Dayton, Ohio, and evaluation at McCook Field under project number P-25. The result was an order for 52 Avro 504Ks (100 h.p. Gnome Monosoupape or 80 h.p. Le Rhône) for the American Expeditionary Force 3rd Instruction Centre at Issoudun, France, in July 1918. After the war they were shipped to the U.S.A. and taken over with all available spares by the Interallied Corporation, one forming the only British exhibit at the Chicago Aero Show in January 1920. A Miss Nellie Brown Duff bought one but the majority were sold to barnstormers, not the least of whom was Charles Kingsford Smith (later Air Commodore Sir Charles Kingsford Smith) who in 1920 toured California with a 504K of the Moffett-Starkey Aero Circus as pilot and stunt man. In June 1920 Lts. Runser, Turner and Freeland flew round the U.S.A. in a Clerget Avro with the intention of giving flights in every State, and early in the following year the Lawrence Sperry Aircraft Co. Inc. acquired all remaining stocks from Interallied. As late as 1928 there were still 15 on the U.S. civil register, at least two of which were preserved, *NC5918* restored to flying condition in 1963 by Cole Palen of Old Rhinebeck, N.Y., and *NC710* kept in the Thompson Products Museum, Cleveland, Ohio. The latter has a 504L fin and last flew at Arcola Airport, New Jersey, in 1936. A third 504K was stored in Connecticut in 1961 by a Mrs. Jared H. Galup.

Aircraft details:

(*a*) **Evaluated at McCook Field**

Avro 504J *C4312*, project number P-25, British demonstrator 1917–18; U.S. serial *94022*, project P-118, 100 h.p. Gnome Monosoupape, crashed, pilot, Capt. Inglis; project P-119, no information; *94023*, P-141, surveyed 25.10.20; *94062*, P-142, salvaged aircraft.

Seven shipped to the U.S.A. after 1918 were *62953–59*.

(*b*) **Civil conversions**

At least *N-ABCA*, *'CC* and *'CE* (1922 Registry)

NC156, *206*, *218*, *260*, *710*, *1286*, *1864*, *2490*, *2718*, *3170*, *5244*, *5664*, *5918*, *7648*, *NC868M* (1928 Registry).

Note: The following Avro 504Ks were sold abroad but remained untraced. *D1631* and *F2547* by Handley Page Ltd., Cs. of A. 7.5.20; *H1978* and *F8828* by Handley Page Ltd., Cs. of A. 16.11.20; *G-EBEL/E3291* and *E4201* by the London Aviation Company, Cs. of A. 15.8.22; *G-EBGV/E9358*, C. of A. 26.6.24, *E442* and *H2551*, Cs. of A. 22.9.25, *H6654*, C. of A. 2.10.26, all by the Aircraft Disposal Co. Ltd.



The prototype Avro 504L two seater *C4329* on the beach at Hamble early in 1919, showing the original four-strut undercarriage.

Avro 504L

First peace-time 504K variant was the Avro 504L training seaplane. The prototype conversion, *C4329*, used two wooden, pontoon-type, single step main floats, each attached to the fuselage by two steel struts, as well as tail and wing tip floats bolted directly to the main structure. A large curved fin was fitted to compensate for the extra keel surface forward and the fairing of the fuselage sides was improved to conform more closely to the shape of the cowling. To give a reasonable take-off performance the higher powered 130 h.p. Clerget was fitted and trials conducted at Hamble in February 1919 led first to the fitting of a four bladed airscrew and the removal of the small wing tip floats. Later the main undercarriage was strengthened by means of an additional strut to the rear of each float.

The Avro 504L did not meet any R.A.F. requirement and was not adopted, nevertheless the Avro company built a considerable number of float undercarriages. The Hamble works also produced six short range float-equipped three seaters for the Avro Transport Company. Still more power was needed and a proposal to fit the new 170 h.p. A.B.C. Wasp I radial was turned down after trials with this engine in *K-147*, a 'guinea pig' 504K from the same production batch. The 150 h.p. Bentley B.R.1 rotary therefore became the standard engine and drove a two bladed airscrew.

G-EANB, last of the six, was certificated too late in the season to be gainfully employed but the other five were all used for joyriding. Piloted by Capt. F. Warren Merriam one worked the Isle of Wight resorts and Hayling Island, and the others went to Paignton, Devon. Flights over Torbay and to Teignmouth proved very popular and 250 passengers were carried during

August–September 1919. On August 25, two 504Ls (in all probability *K-145* and *G-EAJX*), flew along the South Coast en route to an autumn joyriding season at the First Air Traffic Exhibition, Amsterdam. One refuelling in Dover Harbour but the other forced landed off Ramsgate with petrol shortage and had to be towed in. Their replacements *G-EALH* and *'LI* were withdrawn to Hamble but *K-146* (Capt. Evans) was wrecked off Alderney in fog on October 5 while carrying newspapers to Guernsey.

Operations begun on Windermere under C. Howard Pixton on August 4, 1919 were quite remarkable. His aircraft were not true 504Ls but float-equipped 504Ks (130 h.p. Clerget) and without the third undercarriage strut. In common with the majority of Avro Transport Company machines at that time, they flew with enlarged Service markings, in this case *H2581* and *'82* (later *G-EADJ* and *'DK*). They used the slipway and hanger at Bowness formerly occupied by the Lakes Flying Company and continued the lucrative pleasure flights pioneered eight years earlier by the Avro-built Water Bird. The suspension of night mail boat services to the Isle of Man also gave Pixton the opportunity of making twelve 90 minute early morning crossings to Douglas with 3 cwt. parcels of the *Daily News*.

The Eastbourne Aviation Co. Ltd. embarked on a South Coast joyriding season of its own and produced six float-equipped 504Ks. These were also without the third undercarriage strut, and the three occupants sat one behind the other in separate cockpits. The enterprise ended late in 1920 with a seaplane race as grand finale at Hove, Sussex, on August 19 during which *G-EAJH* sank with a collapsed undercarriage. Maj. J. P. B. Ferrand carried 350 passengers in the former Windermere machine *G-EADK* at Folkstone in 1920 but Avro waterborne activities then ceased round the British Isles. In 1921 the Aircraft Disposal Co. Ltd. sold the new production 504L *G-EANB* and two others (almost certainly *H1911* and *'12*) in Sweden to Kungl. Vattenfallsstyrelsen (Royal Waterfalls Committee) as *S-IAA*, *'AB* and *'AG*. They were used in connection with power station construction in North Sweden. Later two were flown inside the Arctic Circle for seven months by Gosta



K-144/G-EAFB, first of the Eastbourne Aviation Co. Ltd.'s joyriding 504Ls (three individual cockpits), taxying out at Hove, Sussex, in August 1920. (*Photo courtesy of the Royal Aero Club.*)



Canadian Air Board forestry patrol Avro 504L *G-CYAX*, showing the revised undercarriage strutting used on the majority of conversions. (*R.C.A.F. Photo.*)

Hulstrom and Ing. Holmen who made 106 return journeys between Porjus and Suorva, flew 23,820 km. in 202 hours 53 minutes flying time and carried 362 passengers plus 6,681 kg. of mail. One Eastbourne 504L, *G-EASD* purchased for £400 by Ing. G. Spaak, also went to Sweden in 1921.

Activities elsewhere were confined to idyllic flights from Bermudan beaches in 1920 by two 504Ls of the Bermuda and Western Atlantic Aviation Co. Ltd.; from Manly Bay, Sydney Harbour, by one of the Australian Aircraft and Engineering Company's imported machines (without dorsal fin) and later by two Imperial Gift 504Ls of the R.A.A.F.; at Mission Bay, Auckland, by two Imperial Gift aircraft of the New Zealand Flying School; in Canada where a few Imperial Gift float undercarriages were brought into use to enable 504Ks to operate from lakes on forestry patrol; and at Valparaiso where three 504L trainers (130 h.p. Clerget) were used by the Chilean Naval Air Service.

A British Mission led by Col. the Master of Sempill, sent out to advise the Imperial Japanese Navy in 1921, took with it a selection of British machines including ten Hamble-built Avro 504Ls. Maj. Orde-Lees and Mr. H. Crisp trained the first Jap naval pilots on these at Kasumigaura, near Tokyo, from which on September 3, 1921 they made a mass formation flight to escort the Crown Prince's warship and all landed in Yokosuka Harbour. When Japan purchased the manufacturing rights from A. V. Roe, Bentley powered 504Ls were built for the Navy by Nakajima. They were without the strengthened undercarriages and their performance deteriorated considerably when the B.R.1s wore out, the only available replacement engine being the licence built 110 h.p. Le Rhône (see p. 124). One Avro 504L remained in service with the Japan Air Transport Research Institute of Osaka until 1927.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Hamble Aerodrome, near Southampton, Hants.
The Eastbourne Aviation Co. Ltd.
Nakajima Hikoki Seisaku Sho (Nakajima Aircraft Manufacturing Co.), Ohta-Machi, Tokyo, Japan

Power Plants: One 110 h.p. Le Rhône
One 130 h.p. Clerget
One 150 h.p. Bentley B.R.1

Dimensions: Span 36 ft. 0 in. Length 32 ft. 1 in.
Height 11 ft. 4 in. Wing area 330 sq. ft.

Weights: Tare weight 1,408 lb. All-up weight 2,006 lb.

**Performance:* Maximum speed 87 m.p.h. Cruising speed 75 m.p.h.
Initial climb 650 ft./min. Endurance 2 hours

*With 130 h.p. Clerget engine.

Production:

(*a*) **By A. V. Roe and Co. Ltd.**

C4329, Clerget engined prototype; c/n A.T.C.12 and 13, Cs of A. 12 and 7.8.19, *K-145/G-EAFF* sold in Belgium 7.21 and *K-146/G-EAFG* wrecked off Alderney 5.10.19. A.T.C.15–18, *G-EALH*, C. of A. 26.8.19; *'JX*, C. of A. 20.8.19; and *'LI*, C. of A. 3.9.19; all s.o.r. 10.20. A.T.C.18, *G-EANB*, C. of A. 6.11.19, to Sweden 7.21 as *S-IAA* "Masen", re-registered *S-ABAA* in 1923, s.o.r. 16.10.26

(*b*) **504K conversions by A. V. Roe and Co. Ltd.**

G-EADJ/H2581, C. of A. 26.6.19; *G-EADK/H2582*, C. of A. 2.8.19; *G-EAGU/H2585*, C. of A. 16.8.19; *G-EAKA/H2590*, C. of A. 27.8.19; sold abroad 8.21; *G-EALB/H2589*, C. of A. 17.9.19

(*c*) **By the Eastbourne Aviation Co. Ltd.**

c/n E.1–E.6: *K-144/G-EAFB*, C. of A. 22.7.19; *G-EAJH*, C. of A. 22.8.19, sank off Hove, Sussex 19.8.20; *G-EALO*, C. of A. 19.9.19, crashed 2.21; *G-EANS*, C. of A. 20.10.19, crashed 9.20; *G-EASD*, C. of A. 1.6.20, to Sweden 3.21 as *S-AAP*, re-registered *S-AHAA* in 1923 and *SE-HAA* in 1928; *G-EASE*, C. of A. 10.9.20

(*d*) **Imperial Gift conversions**

G-CYAS/H2044, *G-CYAX/H2041*, *G-CYDA/H2045*, *G-CYEE/E361* and *G-CYEG/H9729* for Canadian Air Board forestry and fire patrols; *A3–46/H3034* and *A3–47/H3042* by the Royal Australian Air Force; *H2986* and *G-NZAC/H2990* by the New Zealand Flying School, Mission Bay, Auckland

(*e*) **Other conversions**

S-IAB and *S-IAG*, believed ex *H1911* and *H1912*, Cs. of A. issued 21.1.21. *S-IAB* re-registered *S-AAAA* in 1923, s.o.r. 16.10.26; *S-IAG* destroyed by gale 12.22

(*f*) **By Nakajima**

Imperial Japanese Navy serials commencing *J.N.752* in 1921, reaching at least *R.603*, *R.604* and *R.605* in 1926



The Avro 504M three seat cabin machine *K-134*/*G-EACX* at Hendon in July 1919.

Avro 504M

In the spring of 1919 Hamble was very busy converting Avro 504Ks for the Avro Transport Company and produced the six 504Ls, a number of Avro 536 five seaters and single examples of two dissimilar cabin variants. First of these, built in April of that year, was the Avro 504M, a standard 504K modified above the top longerons to form a claustrophobic enclosure accommodating two passengers in staggered seats behind the pilot.

A curved plywood roof with two glazed portholes in each side was hinged along the port longeron. After it was opened the pilot entered by raising a further section of roofing, and once in, viewed the landscape through five vertical Triplex panels mounted round the edge of the cockpit. A light fabric covered structure faired the cabin smoothly into the tail and additional side area was compensated by the addition of a 504L-type dorsal fin. Despite the considerable weight penalty, improved streamlining made it faster than the standard 504K.

The Avro 504M was unusual among British civil Avros in having a 100 h.p. Gnome Monosoupape nine cylinder rotary. It was certificated on June 25, 1919 with the temporary registration *K-134* and next day R. F. Park flew it to Chorley Wood Common, Bucks. to pick up a newly married pair outside the church. After a refuelling stop at Bournemouth, the 504M landed the honeymoon couple at Fowey, Cornwall, in an elapsed time of four hours. The machine then returned to Hounslow Heath and spent the rest of the summer doing a roaring trade among ladies wishing to fly over London without donning special flying kit. Avro's manager G. L. P. Henderson made many charter flights in it including return trips to Aintree on July 8 and Brighton on July 13. Its one recorded overseas flight took place in the early hours of September 6 when Capt. R. T. Fagan flew nonstop from Hounslow to Le Bourget in 2 hours 45 minutes with Norwegian passengers Robshon and Waase.

Many hours were flown during the railway strike, by which time the permanent marking *G-EACX* had been applied but the C. of A. was not renewed in 1920, no doubt due to the very cramped accommodation of such a primitive conversion. When the Japanese acquired 504K manufacturing rights in 1921, they quickly produced a 504M equivalent known as the Aiba Tsubami IV with 150 h.p. Gasden Jimpu engine, one example of which, *J-BABC*, was still in use in 1928.

SPECIFICATION AND DATA

Manufacturer: A. V. Roe and Co. Ltd., Hamble Aerodrome, near Southampton, Hants.

Power Plant: One 100 h.p. Gnome Monosoupape

Dimensions: Span 36 ft. 0 in. Length 29 ft. 5 in.
Height 10 ft. 5 in. Wing area 330 sq. ft.

Weights: Tare weight 1,220 lb. All-up weight 1,975 lb.

Performance: Maximum speed 98 m.p.h. Cruising speed 85 m.p.h.
Climb to 8,000 ft. 5·5 min. Endurance 3 hours

Production: One aircraft only, *K-134*/*G-EACX*, c/n A.T.C.10; sole owner A. V. Roe and Co. Ltd.; C. of A. issued 25.6.19, not renewed in 1920



The first, short lived, Avro 534 Baby prototype.

Avro 534 Baby

After the Armistice A. V. Roe was impatient to return to low powered flying and build a light aircraft of 600 lb. all-up weight with an engine of 20–30 h.p. which could disport itself within the confines of any large field. Chief designer Roy Chadwick favoured an aeroplane with a heavier wing loading, an engine of 40–50 h.p., and cross country capability. Final design was dictated by engine availability, the only suitable one in existence being A. V. Roe's 35 h.p. Green which had been preserved by Mr. Fred May of the Green Engine Co. Ltd. It is said that this engine was fitted originally to the first Avro Type D biplane for Pixton's flight to Brighton on May 6, 1911.

The little Avro 534 was designed round this veteran power plant and although at first named the "Popular", soon acquired the type name Baby. The Green Engine Co. Ltd. completely modernised the engine and fitted aluminium pistons, new type camshaft, valve gear and oil pressure regulator. Cooling was by traditional nose radiator. The Baby was an equal span, single bay biplane of wire braced, fabric covered wooden construction with ailerons on all four wings and the balance area of the famous Avro comma rudder was increased slightly to make it an accurate circle. About a dozen of these machines were built singly at Hamble and eight of them helped to lay sure foundations for the light aeroplane movement which came seven years later. Their Green engines, even lighter than the remodelled original, were specially built by Peter Brotherhood Ltd. of Peterborough from a complete set of manufacturing drawings found in the Green Engine Company's archives.

The prototype Baby emerged on April 30, 1919 and it is said that its total flying life of 2 minutes ended when H. A. Hamersley spun into the Hamble foreshore from 300 ft. when the ignition switches were cut inadvertently. The same pilot won the handicap section of the Aerial Derby at Hendon on

June 21, 1919 at an average speed of 70·3 m.p.h. in *K-131*, usually regarded as the first Avro Baby. It certainly had the same engine but a number of minor differences identify it as actually the second machine of the type, first flown at Hamble May 10, 1919. As if to emphasise that the Baby was no low powered freak, Hamersley won the Victory Trophy Race at Hendon at 77 m.p.h. in July and flew nonstop from Hounslow Heath to Brussels in 2 hours 50 minutes in August, afterwards flying on to the First Air Traffic Exhibition at Amsterdam. The machine was dazzle painted and carried the words 'Avro Baby' in large white letters. The original marking *K-131* remained, but for the overseas flight the permanent registration *G-EACQ* was painted in white on the sloping decking.

On its return the elevator control system was modified so that cables previously carried within the fuselage now ran externally from double-ended cranks mounted on a cross shaft behind the pilot. The Baby then gave aerobatic displays along the South Coast to publicise the joyriding Avro 504Ks. Chadwick, who had just been taught to fly by Hamersley, frequently went cross country in it but when flying low on January 13, 1920 an abnormal bump deposited the aircraft on the ground in the garden of the Rev. Everard Verdon Roe's Hamble Vicarage. Chadwick was gravely injured and eyewitness accounts suggest that the Baby was a complete wreck and it is probable that the rebuilt aircraft incorporated only the engine and primary structure of the earlier machine. Registration *G-EACQ* was retained and many detail improvements were made. These included a raised tailplane; tapered ailerons; a slightly taller, oval shaped rudder; a new oil tank without projecting filler cap; more streamlined interplane struts and the pitot head repositioned on the top wing. H. J. 'Bert' Hinkler bought it in April 1920 and on May 31 made a sensational 650 mile nonstop flight from Croydon to



Hinkler's famous Turin flight Baby *G-EACQ* at Hamilton, V., Australia, as *VH-UCQ* in 1936.



Avro 534A Water Baby *G-EAPS* with revised vertical tail surfaces, ready for launching at Hamble, November 1919.

Turin in 9½ hours for which he was later awarded the Britannia Trophy. He went on to Rome and flew back in easy stages, reaching Hamble on June 10. The machine was then exhibited at the Olympia Aero Show and on July 24 came second in the Aerial Derby Handicap at Hendon, piloted by the owner.

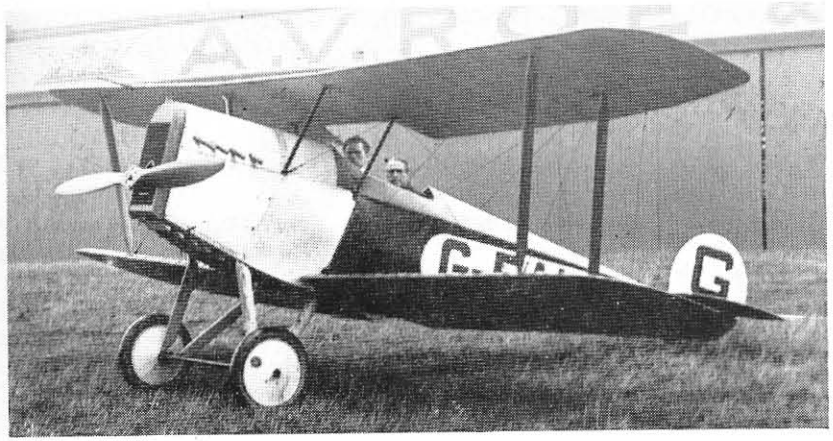
The Avro 534A Water Baby, a second machine built in October 1919, was a twin float seaplane similar to the rebuilt prototype. It had an unbalanced rudder hinged to a large fin, and a slight reduction in lower mainplane span which imparted a slant to the interplane struts. Flown from Southampton Water, the Water Baby performed very creditably despite water soakage.

Designated Avro 534B by virtue of its plywood covered fuselage and slightly shortened bottom wing, the third Baby *G-EAUG* reverted to the perfectly circular rudder. Piloted by Hamersley it just beat Hinkler to win the 1920 Aerial Derby Handicap but was destroyed soon afterwards with serious injuries to Avro pilot D. G. Westgarth-Heslam. The control column universal joint failed during a forced landing with choked carburettor while he was en route to Martlesham to fly the Avro 547 in the Air Ministry Commercial Aeroplane Competition.

The next machine, produced in July 1920, was the Avro 543 Baby *G-EAUM* two seater which housed pilot and passenger in an enlarged single cockpit. It was otherwise a standard Baby with the front fuselage lengthened by 2 ft. 6 in. and on test carried Hinkler and Chadwick to 11,000 ft. Flown by Capt. T. Tulley, it averaged 73·67 m.p.h. in the 1921 Aerial Derby but was forced down at Brooklands and fared no better in the 1922 and 1923 King's Cup Races. In 1926 *'UM* went to Shoreham under the joint ownership of L. E. R. Bellairs and F. G. Miles who removed the ancient Green and attendant plumbing in favour of a 60 h.p. A.D.C. Cirrus I aircooled engine, gravity fed from a large centre section tank. A later owner R. A. Whitehead

overturned it in a forced landing at Bury St. Edmunds during the 1928 King's Cup Race, after which it was bought by H. H. Leech for the 1929 race. He sold it to Roper Brown at Southend in 1932. A projected Cirrus I conversion of a single seat Baby as the Avro 534G did not materialise.

All later Babies were equally remarkable. Avro 534C *G-EAXL* had the span of both wings further reduced for the Aerial Derby of July 16, 1921 but Hinkler forced landed at Sidcup, Kent. During an air test at Hamble on September 6, 1922 (eve of the first King's Cup Race) the engine cut at low altitude and Hinkler got a ducking when *'XL* fell into Southampton Water. The special Avro 534D Baby *G-EAYM* which first flew at Hamble on



The two seat Avro 543 Baby *G-EAUM* at Hamble, July 1920, in its initial form with 35 h.p. Green engine.



G-EAUM at Shoreham 1926 with 60 h.p. A.D.C. Cirrus I aircooled engine.



The clipped wing Avro 534C racer at Hamble, June 1921.

September 14, 1921 had all-steel engine bearers, oversize radiator, extra cowling louvres, slightly taller undercarriage, and a luggage locker behind the pilot's seat. It was built to the order of Col. E. Villiers, an ex R.A.F. pilot who flew it at Dum Dum, Calcutta, as a means of inspecting his business interests. This Baby was still flying in 1928.

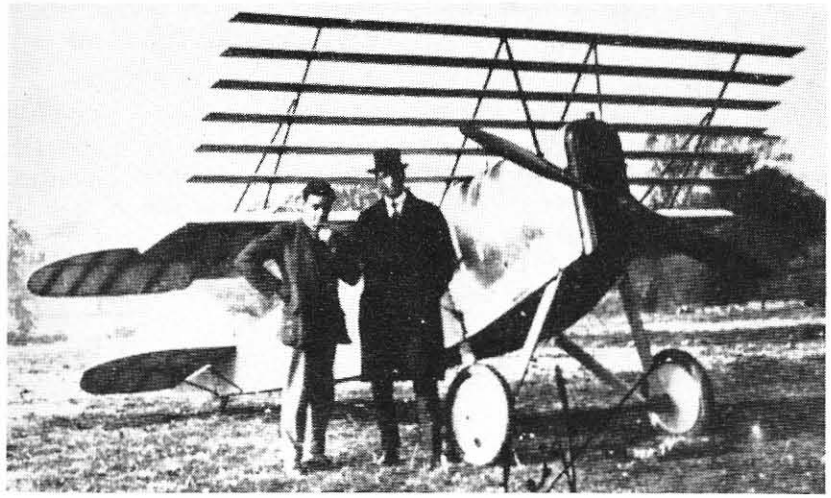
Projected variants with folding wings (Avro 534E) and 100 h.p. Bristol Lucifer (Avro 534F) were not built, but in accordance with the Soviet practice of buying single examples of outstanding aircraft, standard Avro 534 single seater *G-EBDA* was collected from Hamble by Russian pilot Gwaiter in May 1922. His delivery flight from London to Moscow was the first ever made between these capitals. Last of the breed to fly was the Avro 554 Antarctic Baby, a photographic survey development of the projected Le Rhône engined Avro 544 Baby two seater. Identified by rounded wing tips it was built in 1921 for the Shackleton-Rowett South Polar Expedition. Limited shipboard stowage space called for swift dismantling and erection by gloved hands without rigging problems. Tubular steel struts therefore replaced flying wires, N-type interplane struts were used, and all bolts were extra large. An 80 h.p. Le Rhône rotary completely altered the shape of the nose and the tailplane was raised above the fuselage and adjustable for incidence on the ground. After trials on Southampton Water by Maj. C. R. Carr, Shackleton's pilot, the Avro 554 was embarked in the *Quest* at Tower Bridge and left for the far south. Engine trouble in the *Quest* compelled Shackleton to proceed direct to Rio de Janeiro, so that he was unable to collect parts of the aircraft left at Cape Town by an earlier vessel, or to use the 554 on the expedition. The missing components were collected on the return journey and the complete aeroplane arrived back in the *Quest* on September 16, 1922.

In 1923 the Antarctic Baby was purchased by Capt. R. S. Grandy on behalf of Bowring Bros. Ltd. of St. John's and registered *G-EBFE* for test flying on wheels at Hamble. Fitted with skis, it was shipped to Newfoundland for seal spotting and occupied a platform on the stern of Bowring's sealer *Neptune*. A

hostile crew refused to allow it to fly but in 1924 Grandy took off from an icefloe alongside the *Eagle* and spotted a herd of 125,000 seals. The Baby was flown for three more seasons by C. S. 'Jack' Caldwell and retired in favour of an Avro Avian in 1927.

After the 1920 Aerial Derby Hinkler decided to ship the Baby *G-EACQ* to Australia and had the engine bay modified so that he could do single handed overhauls in the outback and even remove cylinders with the engine in situ. The machine was first exhibited at the Royal Sydney Easter Show and on April 11, 1921 Hinkler made the now historic 800 mile nonstop flight from Sydney to his native Bundaberg where he landed in the main street and taxied up to his garden gate. The Baby had now been registered *G-AUCQ* and during the return flight on April 27, overturned on a remote beach in tropical rain. When righted, it was towed 16 miles to Newcastle by horse team and entrained for repair at Sydney where it was sold to H. E. Broadsmith who designed and built a set of floats to the order of a film company. Resulting from several flights from the waters of Botany Bay in 1922, he advised the company that the Baby would be unsuitable for operation in New Guinea and *'CQ* later reverted to a wheeled undercarriage with the front legs farther aft as on Villiers' Avro 534D. After a period as an attraction at a Queensland garage, it passed to W. E. Hart and later to F. Fitzalan of Melbourne, to whom it was re-registered *VH-UCQ* in 1928. As late as December 1936 a flight of 200 miles from Melbourne to Hamilton, Victoria, was made by final owner J. J. Smith.

One Baby was used by H. G. Leigh for experiments with narrow chord



H. J. Hinkler and H. G. Leigh at Hamble in December 1920 with the experimental 'Venetian blind' wing Baby.



The tropicalised Avro 534D Baby built for India.



Maj. C. R. Carr taxying the Avro 554 Antarctic Baby on Southampton Water in 1921.

multiple aerofoils at Hamble in December 1920, but a number of unused airframes remained in store until F. G. Miles bought them early in 1929. His prototype Southern Martlet *G-AAII*, first flown at Shoreham in August that year, was not (as is often supposed) a conversion of one of these. It resembled the Baby externally and used most of its metal fittings, but the timber work was completely new and the engine mounting, undercarriage and tail unit were of entirely new design.

SPECIFICATION AND DATA

Manufacturer: A. V. Roe and Co. Ltd., Hamble Aerodrome, near Southampton, Hants.

Power Plants:

(Avro 534 and 543)	One 35 h.p. Green
(Avro 543)	One 60 h.p. A.D.C. Cirrus I
(Avro 554)	One 80 h.p. Le Rhône

Dimensions, Weights and Performances:

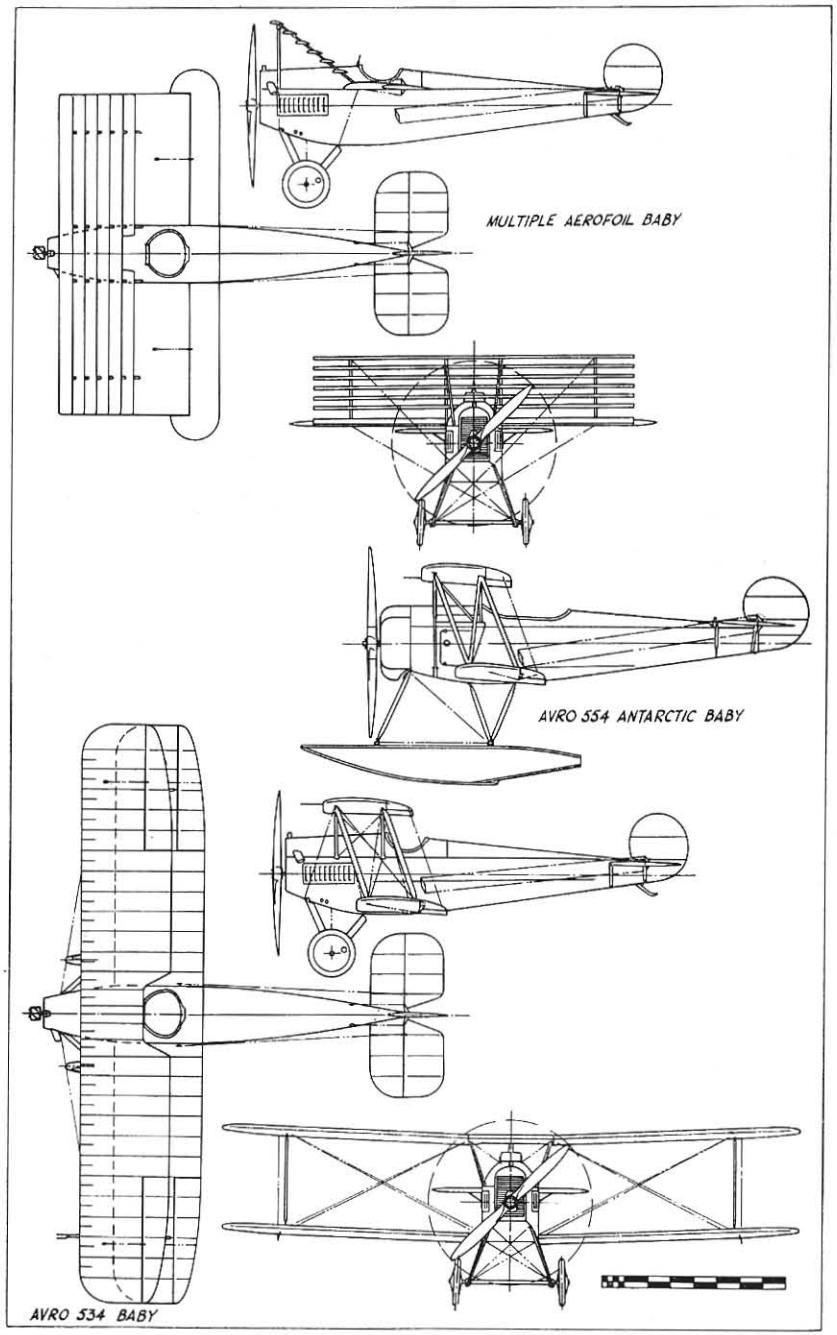
	Avro 534	Avro 534C	Avro 534D	Avro 543	Avro 554
Span (upper)	25 ft. 0 in.	20 ft. 0 in.	25 ft. 0 in.	25 ft. 0 in.	26 ft. 3 in.
Span (lower)	25 ft. 0 in.	18 ft. 0 in.	25 ft. 0 in.	23 ft. 0 in.	24 ft. 0 in.
Length	17 ft. 6 in.	17 ft. 6 in.	17 ft. 6 in.	20 ft. 0 in.	22 ft. 5 in.
Height	7 ft. 7 in.	7 ft. 7 in.	7 ft. 7 in.	7 ft. 7 in.	10 ft. 3 in.
Wing area	180 sq. ft.	—	176·5 sq. ft.	176·5 sq. ft.	184·5 sq. ft.
Tare weight	616 lb.*	—	656 lb.	630 lb.	980 lb.
All-up weight	870 lb.*	—	950 lb.	970 lb.	1,569 lb.
Maximum speed	80 m.p.h.	—	—	82 m.p.h.**	90 m.p.h.
Cruising speed	70 m.p.h.	—	—	65 m.p.h.	70 m.p.h.
Initial climb	500 ft./min.	—	—	500 ft./min.	330 ft./min.
Range	200 miles	—	370 miles	225 miles	190 miles

*With postwar Green engine 610 lb. and 825 lb.
The Leigh multiple aerofoil Baby 675 lb. and 921 lb.
**98 m.p.h. with A.D.C. Cirrus I engine.

Production:

Constructor's No. and Registration		*Registered*	*Details*
—	—	—	Prototype: crashed at Hamble 30.4.19
534/1	*K-131*	29. 5.19	Avro 534: later *G-EACQ;* first flown 16.5.19; 4.20 H. J. Hinkler; to Australia 4.21 as *G-AUCQ*; re-registered 1928 as *VH-UCQ*: s.o.r.* 1936
534/2	*G-EAPS*	21. 11.19	Avro 534A: crashed 7.9.21
534B/1	*G-EAUG*	9. 7.20	Avro 534B: crashed near Ipswich about 3.8.20
543/1	*G-EAUM*	12. 7.20	Avro 543: C. of A. issued 3.8.23; c/n amended to 5062 at engine change 1926; 11.27 L. E. R. Bellairs and F. G. Miles; 7.28 R. A. Whitehead; 9.28 H. H. Leech; 9.29 H. R. A. Edwards; 8.32 Roper Brown; s.o.r. 12.34
534C/1	*G-EAXL*	27. 6.21	Avro 534C: crashed in Southampton Water 6.9.22
5049	*G-EAYM*	17. 9.21	Avro 534D: first flown 14.9.21; withdrawn from use at Calcutta in 1929
5064	*G-EBDA*	28. 4.22	Avro 534: sold in Russia 13.6.22
5040	nil	—	Avro 554: built 1921; registered to Avro 1.2.23 as *G-EBFE*; to Newfoundland 1923; scrapped 1927

*Struck off register.





The prototype Avro 536 *K-114/G-EACC* at Hamble in May 1919 in its original form without dorsal fin.

Avro 536

Reference has been made in previous chapters to a unique batch of civil aircraft built in the Hamble works between April and November 1919. To satisfy the enormous demand for pleasure flights, the Avro Transport Company simply had to provide more seats and quickly. The problem was solved by giving some of these Hamble 504K variants a nine inch increase in width to enable four passengers to sit in side by side pairs in the rear cockpit. Each occupant had his own individual windscreen, the rear windscreens being fixed to a strip of decking hinged to the starboard top longeron for ease of entry. In this form, as the Avro 536, the machine was a short range five seater and (as in the case of Avro 504Ls from the same production batch), extra take-off power at the higher all-up weight was given by a 150 h.p. Bentley B.R.1.

The Avro 536 was easily distinguishable from the 504K since the extra nine inches of width resulted in an obvious difference in the spacing of the centre section struts. Sporting a tricolour rudder, but no other markings apart from AVRO in large white letters, the prototype first flew at Hamble in April 1919 one of the first passengers being the Lord Chancellor who flew in it with H. A. Hamersley on the 25th of that month. Eight production 536s which followed plunged immediately into the fray at southern joyriding sites: *K-104* to *K-106* at Hounslow Heath; *K-116* and *K-137* at Southsea; *K-161* at Weston-super-Mare; and *K-166* at Margate. *K-165* is believed to be that sent to the First Air Traffic Exhibition at Amsterdam. A batch of 12 was also put in hand at Manchester but only seven of these were certificated in time to earn money in 1919. Whereas the constructor's numbers of the Hamble batch were prefixed A.T.C. (Avro Transport Company), those built in Manchester were initialled B for Blackpool where three pilots carried 500 passengers in 536s on the day of their introduction.

All Avro 536s had the 504L-type fin to offset the torque of the powerful Bentley rotary except the first three production aircraft, two of which were involved in serious accidents. Capt. H. R. Hastings was killed when *K-106* stalled on approaching to land at Sandhurst at the end of a charter flight from Hounslow on August 8, 1919; and Capt. E. A. Sullock, on direct track from Hounslow to Southend with two passengers on September 9, suffered engine failure over Rotherhithe and put *K-104* down in Southwark Park where it broke its back. A third Avro pilot, Brig. Gen. C. F. Lee C.M.G., who had demonstrated the 504J *C4312* at Washington in 1917, was killed when the fin-equipped *K-161* stalled when coming in to land on Weston-super-Mare sands in the same month.

Unlike other Avro 536s, the prototype boasted a large aerofoil shaped centre section fuel tank and after a few trial flights at Hamble, was fitted with floats and extended fin to become the sole 536 seaplane. It retained the tri-colour rudder and on July 2, 1919 commenced a joyriding season in the Isle of Wight as *K-114*. The pilot was Capt. F. Warren Merriam who flew A. V. Roe daily to and from Hamble while he was on holiday in the island and, assisted by a 504L, completed a two months' lucrative season at Ryde, Sandown, Shanklin and Ventnor. The last two Hamble-built 536s were special aircraft; *K-139/G-EADV* was a two seater with large fuselage fuel tank for experimental work or long distance competition flying, and the other (23rd and last machine on the mixed production line) was converted into a cabin type known as the Avro 546 for three passengers and pilot. Main differences between this aircraft and the contemporary Avro 504M lay in the widened fuselage, open pilot's cockpit, squarish windows below the top longeron and the Bentley B.R.1 engine. Registered *G-EAOM*, the Avro 546 saw little service and only made a few flights at Hamble and West Blatchington Farm, Brighton, early in 1919–20.



The prototype Avro 536 joyriding at Sandown, I.O.W., in seaplane form in July 1919, showing its unique aerofoil shaped centre section tank.



K-137/G-EADC, a standard Avro Transport Company Avro 536 at Southsea in 1919. (*C. A. Nepean Bishop Photo.*)



The unmarked Avro 546 cabin machine, actually *G-EAOM*, at Hamble in December 1919.

When the Avro Transport Company ceased operations a few of its former pilots hired 536s and carried on in 1920 but all eventually returned to Alexandra Park for storage. Four from the tail end of the production line (*G-EAKM–'KP*), completed too late to be used commercially, were also stored. In 1923 F. J. V. Holmes bought *'KN* for use by Berkshire Aviation Tours Ltd. and in 1925 *'KJ*, *'KM* and *'KP* were acquired by Surrey Flying Services Ltd. to take over joyriding from their aged 504Ks.

Bentley rotaries were no longer in service in 1925 and the Surrey Avro 536s were fitted with Clergets. With reduced fuel loads they were very

economical indeed, carrying pilot and four passengers quite satisfactorily on the company's famous 5 minute/5 shilling 'flips'. Low power also made the dorsal fin unnecessary and in 1926–27 the firm erected four additional Avro 536s *G-EBOF*, *'OY*, *'RB* and *'TF*, for which no original construction details were recorded. They were evidently the best of the other airframes still remaining at Alexandra Park (then in process of closing down) and the unexplained constructor's number P.8 given for *G-EBOY* was evidently a corruption of B.8, identifying it as the former *G-EAKL*. They seldom ventured far afield, although *G-EBOY* gave joy flights from the beach at Jersey in 1927 and during a barnstorming tour in 1928 *'RB* was used extensively for wing walking exhibitions.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 536) One 130 h.p. Clerget
One 150 h.p. Bentley B.R.1
(Avro 546) One 150 h.p. Bentley B.R.1

Dimensions: Span 36 ft. 9 in. Length 29 ft. 5 in.
Height 10 ft. 5 in. Wing area 335 sq. ft.

Weights: Tare weight 1,431 lb. All-up weight 2,226 lb.

Performance: Maximum speed 90 m.p.h. Cruising speed 70 m.p.h.
Initial climb 550 ft./min. Ceiling 12,000 ft.
Range 190 miles

Note: The above figures apply to both Avro 536 and 546.

Production:

(*a*) **Hamble built**

K-114/G-EACC, c/n A.T.C.1, C. of A. 3.7.19, prototype flown as landplane 5.19 and as seaplane 7.19, s.o.r. 7.21

A.T.C.2–A.T.C.9: *K-104/G-EAAQ*, C. of A. 14.5.19, crashed in Southwark Park, London 9.9.19; *K-105/G-EAAP*, C. of A. 14.5.19, crashed 12.19; *K-106/G-EAAO*, C. of A. 16.5.19, crashed at Sandhurst 6.8.19; *K-137/G-EADC*, C. of A. 3.6.19, scrapped at Hamble 12.19; *K-161/G-EAGM*, C. of A. 12.7.19, crashed at Weston-super-Mare 1.9.19; *K-165/G-EAHA*, C. of A. 12.8.19, s.o.r. 9.20, believed in the Netherlands; *K-166/G-EAHB*, C. of A. 17.7.19, scrapped at Hamble 12.19; *K-116/G-EACG*, C. of A. 17.6.19, crashed 12.19.

A.T.C.11, *K-139/G-EADV*, experimental long range two seater, scrapped 12.19; A.T.C.23, *G-EAOM*, C. of A. 22.12.19, completed as Avro 546, s.o.r. 12.20

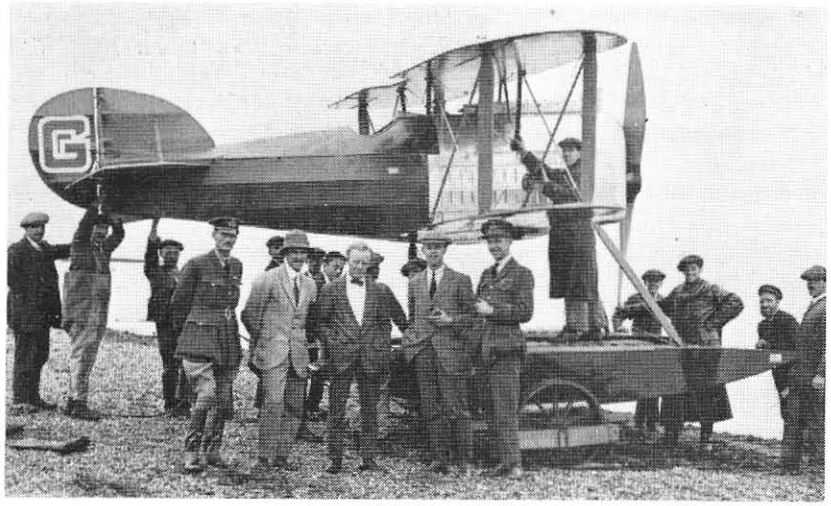
(*b*) **Manchester built**

c/n B.1–B.12: *K-173/G-EAID*, *K-174/G-EAIE* (Fleet No. 19), *G-EAKD*, *K-175/G-EAIF* and *G-EAJR*, all certificated 8.19, placed in storage at Alexandra Park 8.21; *G-EAKJ*, C. of A. 9.9.19, based at Brighton, to Surrey Flying Services Ltd. 4.24; *G-EAKK*, C. of A. 9.9.19 and *G-EAKL*, C. of A. 19.11.19,

both stored at Alexandra Park 8.21; *G-EAKM* to Surrey Flying Services, C. of A. 18.8.25, crashed at Taplow, Bucks. 6.7.28; *G-EAKN* to F. J. V. Holmes, C. of A. 17.4.24, crashed 1.9.24; *G-EAKO* stored at Alexandra Park 8.21; *G-EAKP* to Surrey Flying Services Ltd., C. of A. 15.7.25

(*c*) **Erected by Surrey Flying Services Ltd., Croydon**

G-EBOF, C. of A. 26.6.26; *G-EBOY*, C. of A. 28.8.26; *G-EBRB*, C. of A. 13.5.27, crashed 12.6.28; *G-EBTF*, C. of A. 1.9.27. Surviving three s.o.r. 12.30



The Avro 539 racer at its first launching with the original rounded rudder.

Avro 539

Rushed through the Hamble works in time for the 1919 Schneider Trophy Race, the Avro 539 single seat, twin float seaplane was the smallest biplane that could be designed round the 240 h.p. Siddeley Puma engine. Its wooden structure was typically Avro but there was little external resemblance to any of the company's previous aeroplanes. The fuselage was a rectangular section box-girder with deep curved fairings above and below to conform to the lines of the engine cowlings. These were a close fit with the cylinder heads projecting through them and cooling was by nose radiator.

Single bay mainplanes with rounded tips were rigged with dihedral on the lower, shorter plane only. The tailplane was of generous area and an unbalanced rudder was hinged to a considerable dorsal fin. Four streamlined steel tubes carried two 14 ft. single step wooden floats at a track of 7 ft. but there were no wing tip or tail floats. Piloted by Capt. H. A. Hamersley, the Avro 539 first flew from Hamble slipway on August 29, 1919 but apart from the national *G* outlined in white on the rudder, no marks were carried despite the allocation of registration *G-EALG* eight days before. When taking off for eliminating trials at Cowes on September 3, a float was damaged by floating debris and a separate trial was arranged for September 8. This allowed time not only for repairs but for the fitment of a horn balanced rudder, a change of fin shape and the display of full registration marks under the revised designation Avro 539A. The Schneider contest took place at Bournemouth on September 10, with the Avro 539A acting as reserve British machine to the Sopwith Schneider and the Supermarine Sea Lion I.

These were to compete with French and Italian entries but the race was declared void because of fog.

Deprived of an opportunity of showing its paces, the aircraft returned to Hamble where it was eventually converted into a landplane for the Aerial Derby at Hendon on July 24, 1920. A rigid Vee undercarriage was located well forward as on early Avro Babies, the fin area was reduced, and a small streamlined headrest fitted. Still known as the Avro 539A, *G-EALG* was flown in the race by Capt. D. G. Westgarth-Heslam who forced landed at Abridge, Essex, drenched in fuel.

The unlucky racer then returned to Hamble for a more extensive reconstruction to permit the installation of a 450 h.p. Napier Lion driving a 10 ft. diameter Avro airscrew. By removing the frontal radiator it was possible to rebuild the nose with a downward slope to improve both streamlining and forward view. The three banks of cylinders projected from smoothly tapering cowlings which terminated in a conical airscrew boss, the engine being cooled by small radiator units on each side of the fuselage ahead of the cockpit. With an engine almost twice the power and weight of the original, it was necessary to shorten the nose and to strengthen the fuselage by planking it with plywood. A more robust undercarriage with rubber-in-compression shock absorbers was also necessary.

In this form the machine was re-registered *G-EAXM* under the designation Avro 539B and first flew at Hamble piloted by D. G. Westgarth-Heslam on July 15, eve of the 1921 Aerial Derby Race. At the end of this, its only flight, he made a perfect landing too far up the aerodrome and overshot into a railway cutting leading to the old R.A.F. Assembly Park. The 539B was completely wrecked and the pilot was seriously injured.



Avro 539A *G-EALG* at Bournemouth on September 10, 1919 showing the horn-balanced rudder and enlarged fin. (*'Flight' Photo 750.*)



G-EALG in landplane form at Hendon on July 24, 1920 for the Aerial Derby Race. (*'Flight' Photo 830.*)



The machine after reconstruction as the Avro 539B with Napier Lion engine, running up at Hamble on July 15, 1921.

SPECIFICATION AND DATA

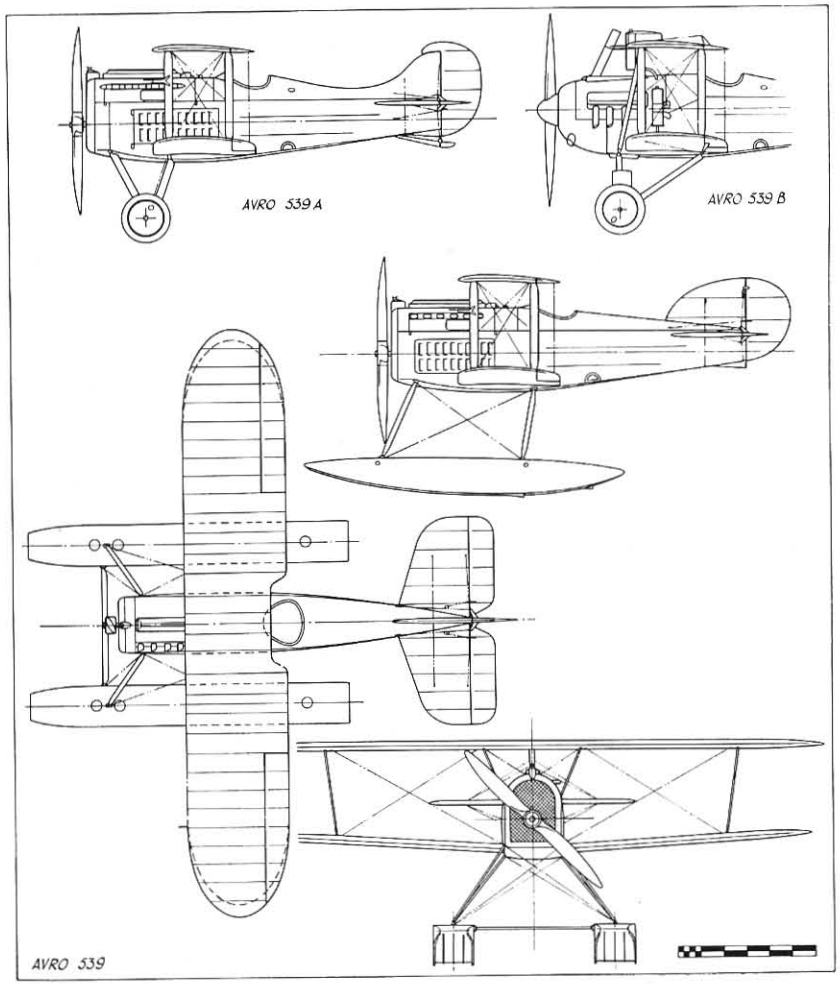
Manufacturers: A. V. Roe and Co. Ltd., Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 539) One 240 h.p. Siddeley Puma
(Avro 539A) One 240 h.p. Siddeley Puma
(Avro 539B) One 450 h.p. Napier Lion

Dimensions: Span (upper) 25 ft. 6 in. (lower) 24 ft. 6 in.
Length (Puma) 21 ft. 4 in.
Height (Puma) 9 ft. 9 in. (Lion) 8 ft. 6 in.
Wing area 195 sq. ft.

Weights: (Avro 539) Tare weights 1,670 lb. All-up weight 2,119 lb.

Production: One aircraft only—Avro 539 *G-EALG*, c/n 539/1, first flown 29.8.19; rebuilt 1920 as Avro 539A *G-EALG*, c/n 539A/1; rebuilt 1921 as Avro 539B *G-EAXM*, c/n 539B/1, damaged beyond repair at Hamble 15.7.21





The Beardmore engined Avro 547 *G-EAQX*.

Avro 547

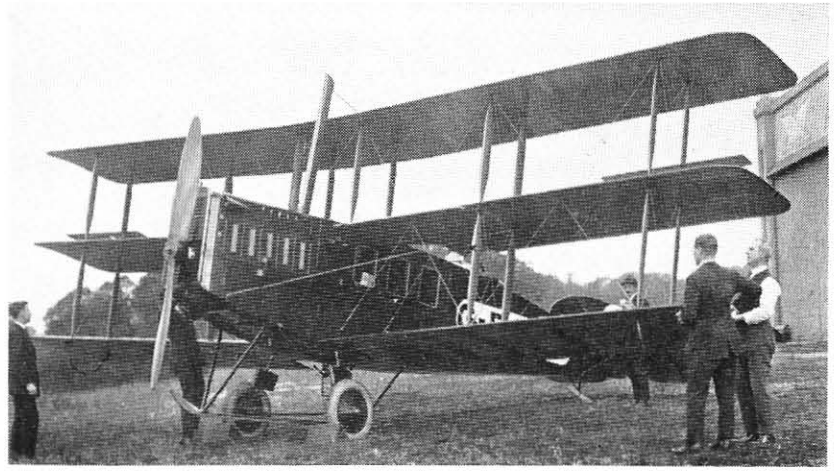
The Avro 547 *G-EAQX* was a commercial triplane with enclosed cabin built in February 1920 and powered by a 160 h.p. Beardmore watercooled engine. Engine mountings and cabin structure were of new design but almost all the remainder of the Avro 547 was built from surplus Avro 504K components. By reverting to A. V. Roe's favourite triplane formula, the span was kept to a minimum while construction was speeded and costs kept low by the ingenious use of standard 504K mainplanes, interplane struts, tail unit and undercarriage. Ailerons were fitted to all three wings, the centre pair being fitted with 'park bench' type aerodynamic balances. The tail unit employed the dorsal fin used on the Avro 504L and 536 and the undercarriage was standard apart from a longer axle and a wider rear Vee strut.

The fabric covered rear fuselage, although of generous proportions and quite unlike that of a 504K, was built in the same manner from spruce strip and used all the 504K metal fittings. Aluminium engine cowlings were used and the fuselage from nose radiator to the rear of the cabin was plywood covered. Fuel and oil tanks were located in a special bay behind the engine and the cabin accommodated four passengers in facing pairs in adjustable, spring mounted bucket seats. With the seats removed, 113 cu. ft. of space was available for the carriage of light freight or mail. An entry door, complete with railway carriage-type, strap operated, opening Triplex window, was on the starboard side. Immediately behind the cabin lay the pilot's open cockpit, offset to port to give adequate forward and downward view, and about two feet of the port centre wing and starboard bottom wing trailing edges were cut back to the rear spar further to improve the view with the tail down.

Capt. H. A. Hamersley flew the machine at Hamble and reported that performance and handling characteristics were much the same as those of the 504K. The airframe was already stressed for engines of higher power, so that when the rules of the Air Ministry Small Commercial Aeroplane Competition were published, it was a simple matter to build a second triplane in June 1920 and fit a 240 h.p. Siddeley Puma. With this engine the calculated performance made it a likely winner and the machine consequently occupied a place of honour on the Avro stand at the Olympia Aero Show in London, July 9–20, 1920. With the competition in mind, several improvements were made in the cabin, notably seven extra inches of leg room, hot and cold air control, interior lighting, upholstered bench type seats and a trapdoor for communicating with the pilot.

Registered *G-EAUJ* under the designation Avro 547A, the machine was flown from Hamble to Martlesham by Capt. H. A. Hamersley and weighed in on August 3 to compete against the Austin Kestrel, Beardmore W.B.X, Bristol Seely Puma, Sopwith Wallaby and the Westland Limousine III (eventual winner of the £7,500 prize). Hamersley was the first competitor to start the tests when he made the glide test from 500 ft. next morning and covered the measured mile at 95·7 m.p.h. Then followed reliability-with-economy, getting off and landing tests at an all-up weight of 3,683 lb., a slow run at 51·5 m.p.h. on August 12 and a measured landing run of 239 yards on the 14th. The machine failed to qualify for an award because it was not inherently stable and had failed to reach the stipulated minimum top speed of 100 m.p.h.

In the landing trial the Avro 547A was put down rather hard and an undercarriage strut was so badly bent that a quarter of an hour later the entire undercarriage collapsed as it stood at dispersal. After repairs it was flown



A. V. Roe and H. A. Hamersley discussing *G-EAUJ*, the Puma engined Avro 547A.

back to Hamble but returned to Martlesham for official trials on October 12. It was flown on this occasion by H. J. Hinkler who stopped for three days of demonstration flights at Croydon en route. The return trip on October 30 followed the same pattern, after which it was based at Hamble until dismantled sometime after its final C. of A. renewal in August 1921.

At the invitation of S. Instone and Co. Ltd. H. J. Hinkler ferried the first machine, *G-EAQX*, to Croydon on June 1, 1920 where it was flown next day by Instone's chief pilot F. L. Barnard. He did not recommend its purchase and further demonstrations at Croydon on June 24 were equally abortive. A third 547 fuselage, built against the possible order, hung from the roof of the flight shed at Hamble until well into 1925 as mute reminder of these failures.

Nevertheless Queensland and Northern Territories Aerial Services Ltd. (QANTAS) purchased *G-EAQX* in November 1920 for £4,000 for the Charleville-Katherine section of its proposed Melbourne–Darwin route, and a twice weekly service between Charleville and Cloncurry. The aircraft was crated and shipped to the Australian Aircraft and Engineering Co. Ltd., the Avro agents, and on arrival in March 1921 was assembled at Mascot. Here the slender main undercarriage legs were replaced by stout, rubber-sprung Vee struts more suited to unprepared landing grounds in Queensland. In this form the 547 was flown into second place in the Australian Aerial Derby at Victoria Park Racecourse, Sydney by QANTAS manager Hudson Fysh on May 6, 1921 at an average speed of 69·5 m.p.h. Soon afterwards the undercarriage collapsed while P. J. McGinniss (co-founder of QANTAS) was giving flights at Mascot prior to his departure for Queensland and the aircraft was then declared unsuitable for commercial flying and dismantled for spares.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants:
(Avro 547) One 160 h.p. Beardmore
(Avro 547A) One 240 h.p. Siddeley Puma

Dimensions:
Span 37 ft. 3 in. Length 29 ft. 10 in.
Height 14 ft. 5 in. Wing area 498 sq. ft.

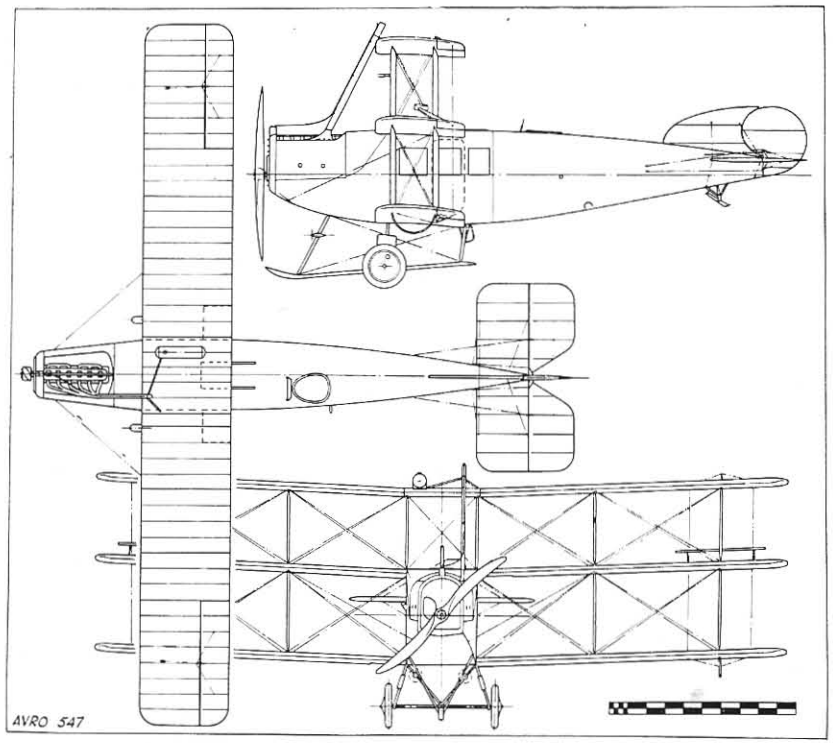
Weights:
(Avro 547) Tare weight 2,077 lb. All-up weight 3,000 lb.
(Avro 547A) Tare weight 2,460 lb.
All-up weight 3,666 lb.*

Performance:
(Avro 547) Maximum speed 96 m.p.h.
Cruising speed 83 m.p.h.
Climb to 5,000 ft. 15 min. 0 sec.
Range 230 miles
(Avro 547A) Maximum speed 95 m.p.h.
Cruising speed 80 m.p.h.
Climb to 10,000 ft. 19 min. 0 sec.
Range 280 miles

*Flown at an all-up weight of 3,683 lb. at Martlesham; maximum permissible gross weight increased to 3,800 lb. at C. of A. renewal 22.8.21.

Production:

Constructor's No. and Registration		*C. of A. Issued*	*Details*
547/1	*G-EAQX*	nil	2.20 A. V. Roe and Co. Ltd.; 11.20 Australian Aircraft and Engineering Co. Ltd.; to QANTAS 6.21 as *G-AUCR*; used as spares at Mascot 6.21
547A/1	*G-EAUJ*	25.8.20	Martlesham competition 3–14.8.20; to Martlesham trials 12–30.10.20; dismantled at Hamble 1922
—	—	nil	Incomplete airframe stored at Hamble until 1925





The Olympia Aero Show model Avro 548 showing the wing root elevator control cranks.

Avro 548

By 1918 successful development of the in-line engine was already ending the long career of the rotary. The in-line was not only less complex and more easily maintained, but less extravagant in fuel and oil. It was not therefore surprising that A. V. Roe's ingenious civil adaptations of the 504K embraced an economical engine of this type, particularly as tens of surplus thousands were to be had at give-away prices.

Experiments began at Hamble in October 1919 with the Avro 545 *G-EAPR*, an experimental 504K with 90 h.p. Curtiss OX-5. This American eight cylinder Vee watercooled engine needed spiral tube radiators on each side of the front cockpit in the manner of the Avro Type E prototype of an earlier era. Such an installation, with its heavy and potentially troublesome plumbing, would not have appealed to private owners and final choice fell on the aircooled 80 h.p. Renault, a similar engine which drove a four bladed wooden airscrew.

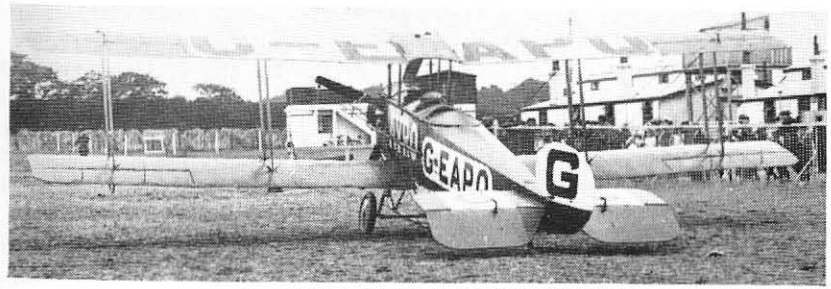
Designated Avro 548, first flown at Hamble by H. A. Hamersley late in 1919, flown to Farnborough for checks on January 13, 1920 and certificated in the following March, the first Renault Avro *G-EAPQ* was a 504K with the dual control removed to carry two passengers in tandem behind the pilot. Fuel, entirely gravity fed, was carried in a large centre section tank and a false decking covered the large rear cockpit so that each occupant had his own windscreen. This machine was the only Avro 548 to have external elevator control wires running from cranks above the lower wing root. Silver overall with polished cowlings, it graced the Avro stand at the Olympia Aero Show, London, in July 1920 without markings as the 'Avro Tourist'. The third Avro 548, *G-EALF*, was available for demonstration flights at Hendon during the Show and on July 28 F/Lt. Leslie flew Prince Alfonso d'Orleans to Farnborough in it.

The trade slump killed any potential market, and a projected trainer version (Avro 553) was shelved, but the prototype was repainted in wartime

drab for Capt. E. D. C. Herne who used it for a photographic survey of the whole of England, the entire coastline of Belgium and France as well as all the major Belgian inland towns. When King George V visited Belfast, *'PQ* was flown 700 miles from Croydon to Belfast and back in one day, yet total repairs after 30,000 miles in 18 months amounted to only £2 for a set of control cables, and 3d. for a valve spring. W. G. Pudney afterwards acquired it and ran a joyriding business at Croydon throughout 1922.

Three other Avros 548s built at Hamble were without the false decking and had a large, double rear cockpit. One was sold in Uruguay and another, *G-EAFH* (formerly *K-147*, 504K test bed for the 170 h.p. A.B.C. Wasp I), spent 1921 at Swansea with the Welsh Aviation Company and won all three races at the Croydon Meeting of September 17, 1921 piloted by F. G. M. Sparks. When the firm went into liquidation, pioneer private owner Dr. E. D. Whitehead Reid of Bekesbourne, Canterbury, bought it for a mere £12 10s., converted it to two seater and flew it in and out of fields on his professional rounds until 1927. *G-EAFH* then returned to joyriding, first at Squires Gate and in 1931 at Southport sands with the Giro Aviation Co. Ltd., finally crashing there on May 31, 1935 during a low altitude aerobatic display. A. V. Roe and Co. Ltd. built only three other 548s, dual trainers *G-EBIT–'IV* for the North Sea Aerial and General Transport Co. Ltd. Reserve School at Brough in 1924.

The majority of Avro 548s were conversions made by outside firms such as the Aircraft Disposal Co. Ltd. which produced ten at Croydon. Only the first of these, *G-EAYD*, resembled Avro's prototype with three separate cockpits. The remainder included five for Reserve Training at Stag Lane by the de Havilland School of Flying Ltd., one of which was the former Avro Transport Company 504K *G-EAAL*. Named "Vida", the latter eventually passed into private ownership at Stag Lane. *G-EBPJ*, privately owned in 1926 by Nigel Norman, served the Norfolk and Norwich Aero Club at Mousehold 1927–28; and *'PO* went to Newcastle Aero Club at Cramlington in the same year.



Rear view of the prototype Avro 548 during its 1922 Croydon joyriding season. Note the three individual cockpits.



Avro's slave aircraft *G-EAPR* in Avro 545 configuration, October 1919, with 90 h.p. Curtiss OX-5 engine.

Surrey Flying Services Ltd. built three; *G-EBAJ* for airborne radio telephony experiments by Marconi's Wireless Telegraph Co. Ltd. at Croydon; *G-EBBP* for private owner Sir Derwent Hall Caine (which later in 1922 reverted to the company for instructional use); and dual trainer *G-AABW* in 1928. The only difference between these and the genuine Avro-built 548 was the bulged under-cowling. When Marconi ceased experiments in 1926, *G-EBAJ* joined the rapidly expanding fleet of the Henderson School of Flying Ltd. at Brooklands. A. B. H. Youell flew it at the next year's Bournemouth Easter Meeting, winning the Business Houses Handicap on April 16, 1927 at an average speed of 74 m.p.h. On October 1 that year it took a prominent part in welcoming home the victorious Schneider Trophy team by flying round Croydon with suitably inscribed yellow banners attached to a crude metal framework. The Henderson School and its successor, the Brooklands School of Flying Ltd., owned nine 548s, six of which they built from spares. Although primarily intended for instructional work, the 548s always went joyriding at coast resorts such as Skegness and Canvey Island in the summer. Two, *G-EBRD* and *'SC*, shipped to South Africa for a pleasure flying season in 1927–28, took part in Cape Town's first air display on December 11, 1927.

The most important Henderson 548 was *G-EAJB*, one of Avro's original 1919 civil 504Ks which had been used at Filton for some years by the Bristol Aeroplane Co. Ltd. as a Lucifer engine test bed. Standard 504K shock absorbers now replaced the special oleo units used at Bristol but *'JB* retained the 504N-type ailerons with curved trailing edge. The only other Avro 548 so fitted was Henderson's second machine *G-EBRD*, built for South Africa.

In 1925 Maj. F. B. Halford of the Aircraft Disposal Co. Ltd. modernised the 80 h.p. Renault by fitting redesigned cylinder heads and valve gear which raised the power output to 120 h.p. This engine, the Airdisco, was fitted into one of the company's surplus 504K airframes to create the first Avro 548A.

Registered *G-EBKN*, it had greatly improved all-round performance and became the lively mount of Shoreham private owner A. G. Head. Not to be outdone in publicity by A. V. Roe and Co. Ltd., donors of an Avro 504R to the Lancashire Aero Club in July 1926, the Aircraft Disposal Co. Ltd. simultaneously presented the club with one of their 548 conversions *G-EBOK*. Soon afterwards, on October 2, T. Neville Stack flew *'OK* to victory in the Yorkshire Open Handicap Race at Sherburn, beating the Brough 548As *G-EBIT* and *'IU*. Together with *'IV*, these had been re-engined with Airdicos but were sold to joyride concerns in 1928 along with *'OK*. *G-EBIV* went to Surrey Flying Services Ltd., Croydon, while *'IT* and *'IU* joined *'OK* at Squires Gate and there became even better known than the 504K.

The last two British 548s, *G-ABMB* and *'SV*, were built at Barton by Berkshire Aviation Tours Ltd. in 1931 for the Giro Aviation Co. Ltd., their sole cross country flying being the delivery flight to Southport where they worked the beaches for several years. Both were replaced by D. H. Fox Moths in 1934–35 but remained fully rigged in the hangar at Hesketh Park until 1938.

A few Avro 548 conversions were also made overseas. The Canadian Aircraft Co. Ltd. of Winnipeg, importers of six 80 h.p. Renaults in April 1920, built three machines and retained two for charter flying. The third was converted for the McCall Hanrahan Aero Service of Calgary but crashed in less than a fortnight. In 1928 they also built the Hawk-Clark Y-Avro Mallard *G-CASY* for W. P. A. Straith, using an old 504K fuselage (believed *G-CAAQ*) with a 75 h.p. Rolls-Royce Hawk engine and Clark Y section wings. In Australia Matthews Aviation Ltd. replaced the Dyak in *G-AUBG* by an Airdisco; and *G-AUBK*, flown by E. W. Percival in the Australian Aerial Derby with an 80 h.p. Renault on May 6, 1922, also later received an Airdisco. The only other example, *G-AUEW*, started life as a Clerget 504K, but was modified progressively to 548 and 548A by E. W. Beckman and Courier Aircraft Ltd. of Brisbane 1926–27.



The Henderson School of Flying joyriding Avro 548 *G-EBAJ* with framework for towing a 'Welcome Home' banner at Croydon when the victorious 1927 Schneider Trophy team returned from Venice. (*'Flight' Photo 5086.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
The Aircraft Disposal Co. Ltd., Croydon Aerodrome, Surrey
Berkshire Aviation Tours Ltd., Barton Aerodrome, Manchester
The Canadian Aircraft Co. Ltd., Winnipeg, Manitoba, Canada
The Henderson School of Flying Ltd., Brooklands Aerodrome, Surrey
Surrey Flying Services Ltd., Croydon Aerodrome, Surrey

Power Plants: (Avro 545) One 90 h.p. Curtiss OX-5
(Avro 548) One 80 h.p. Renault
(Avro 548A) One 120 h.p. Airdisco

Dimensions: Span 36 ft. 0 in. Length 29 ft. 5 in.
Height 10 ft. 5 in. Wing area 330 sq. ft.

Weights and Performances:

	Avro 545	Avro 548	Avro 548A
Tare weight	1,241 lb.	1,338 lb.	1,460 lb.
All-up weight	1,829 lb.	1,943 lb.	2,150 lb.
Maximum speed	—	80 m.p.h.	91 m.p.h.
Cruising speed	70 m.p.h.	65 m.p.h.	84 m.p.h.
Initial climb	—	350 ft./min.	400 ft./min.
Ceiling	—	—	11,200 ft.
Range	210 miles	175 miles	300 miles

Productiom:

(*a*) **By A. V. Roe and Co. Ltd.**

G-EAPQ/H2322, C. of A. 16.3.20, to W. G. Pudney 3.22; *G-EAFH*, c/n A.T.C.14, C. of A. 22.6.20, to Welsh Aviation Co. 5.21, Dr. E. D. Whitehead Reid 3.22, to Giro Aviation Co. 3.31, crashed at Southport 31.5.35; *G-EALF/J743*, C. of A. 8.12.20; *G-EAVH*, c/n 548/4, C. of A. 15.10.20 crashed at Montevideo, Uruguay, 21.8.21; *G-EBIT-'IV**, c/n 5100–5102, C. of A. 9.5.24, North Sea Aerial and General Transport Co. Ltd., *'IT* and *'IU* to the Lancashire School of Aviation Ltd. 2.28, *'IU* damaged beyond repair at Rhyl 17.5.37, *'IV* to Surrey Flying Services Ltd. 5.28.

*Avro 548A with 120 h.p. Airdisco.

(*b*) **By the Aircraft Disposal Co. Ltd. 1921–26**

G-EAAL/E4154, *G-EABG/H2025*, *G-EBFL/H2053*, *G-EBFM/H2070* and *G-EBHL/H2067* for the de Havilland Aircraft Co. Ltd., *'AL* to T. H. Richardson as "Vida", crashed near Stag Lane 4.6.28, *'AG* to Northern Airways Ltd. 6.27, *'FL* crashed 24.7.23, *'FM* to G. L. P. Henderson 5.26 (crashed at Brooklands 20.9.28); *G-EAYD/H7428*, crashed 13.10.21; *G-EBHK/H7488*; *G-EBKN/E449** A. G. Head, Shoreham 2.30; *G-EBOK*, c/n R/R3/Re/70022, Light Planes (Lancs) Ltd., to Lancashire School of Aviation Ltd. 8.28; *G-EBPJ/E9337* Nigel Norman, to Norfolk and Norwich Aero Club 11.27, Inland Flying Services Ltd. 5.28; *G-EBPO/E3387* Newcastle Aero Club.

*Avro 548A with 120 h.p. Airdisco.



G-EBKN, first of the 120 h.p. Airdisco engined Avro 548A machines produced by the Aircraft Disposal Co. Ltd.



G-EBRD, an Avro 548 with tapered ailerons erected by Henderson at Brooklands for the 1927–28 South African tour.

(*c*) **By Surrey Flying Services Ltd. 1922–29**

G-EBAJ/E3043, first flown 17.1.22, Marconi's Wireless Telegraph Co. Ltd., to G. L. P. Henderson 7.26; *G-EBBC/H2212*, D. Hall Caine, to Surrey Flying Services Ltd. 8.22; *G-AABW*, c/n G516*, Surrey Flying Services Ltd., crashed at Welling, Kent, 19.9.29.

*As documented.

(*d*) **By the Henderson School of Flying Ltd. 1927–29**

G-EAJB/H2598, ex Avro 504K; *G-EBRD* scrapped in South Africa 1928; *G-EBSC* crashed in South Africa 5.28; *G-EBVE* to Brooklands School of Flying Ltd. 11.28, damaged beyond repair at Brooklands 1929; *G-EBWH* damaged beyond repair at Canvey, Essex 22.7.28; *G-EBWJ* to Brooklands School of Flying Ltd. 11.28; to C. B. H. Crawshaw, Hooton 5.31; *G-AADT* to Brooklands School of Flying Ltd., to E. Willox, Dyce 11.30.

(*e*) **By the Berkshire Aviation Co. Ltd. 1931–32**

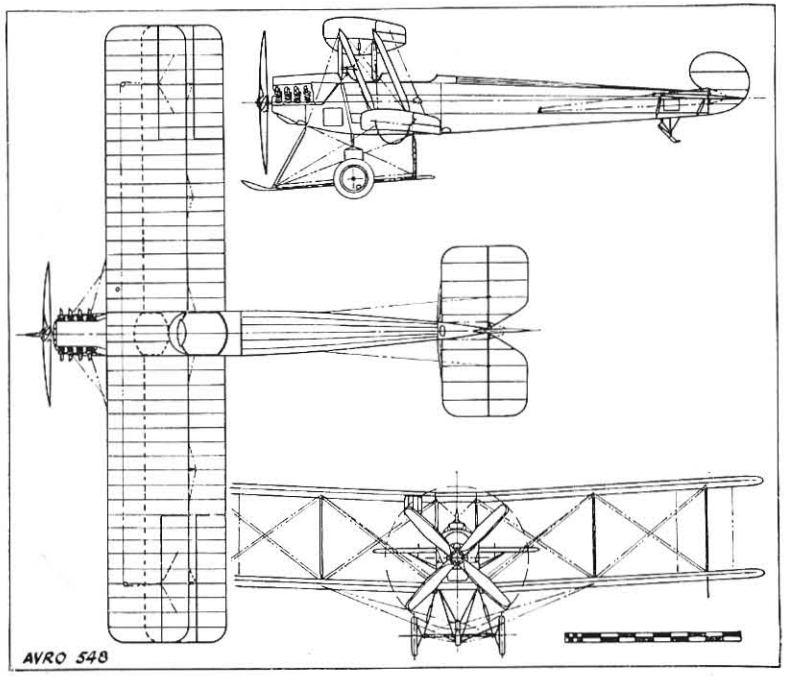
G-ABMB/*H2232*, C. of A. 9.7.31 and *G-ABSV*, C. of A. 7.4.32, for the Giro Aviation Co. Ltd., scrapped at Southport circa 1940.

(*f*) **By the Canadian Aircraft Co. Ltd. 1920–21**

G-CACD, c/n 1160, C. of A. 5.10.20, Canadian Aircraft Co. Ltd.; *G-CACI*/*D8997*, C. of A. 15.6.21, ex Avro 504K *G-CABS*; *G-CACN*, c/n 1161, C. of A. 27.6.21, McCall Hanrahan Aero Service, crashed at Calgary, Alberta 6.7.21. *G-CASY*, Hawk-Clark Y-Avro Mallard, c/n 2, registered 21.5.30, s.o.r. 5.31

(*g*) **In Australia 1920–21**

G-AUBK, E. W. Percival 6.21, to Courier Aircraft Ltd., crashed at Ipswich, Q. 9.2.27; for *G-AUBG* and *'EW* see page 118.





The first prototype Avro 549 Aldershot *J6852* with dorsal fin, running up at Hamble 1922.

Avro 549 Aldershot

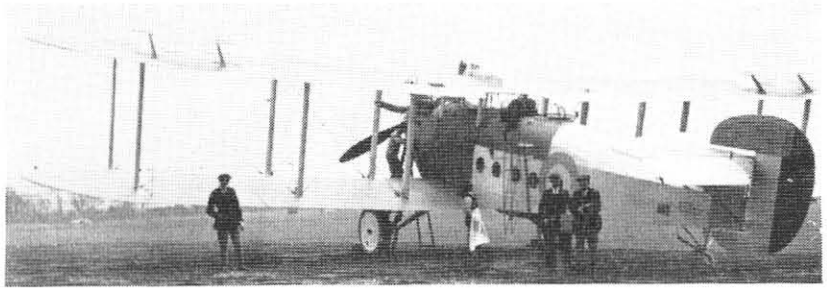
The Aldershot, Avro's first entirely new postwar military aeroplane, was a long range heavy bomber designed by Roy Chadwick and built to Air Ministry Specification 2/20 (D. of R. Type 4B). Powered by a single 650 h.p. Rolls-Royce Condor III, it was historically important as the first Avro type to have a metal fuselage, and featured a capacious plywood covered central cabin divided into two decks. Two pilots sat side by side on the upper (with dual control) with the gunner armed with a single Scarff-mounted Lewis gun, close behind while an internal ladder gave access to the bomb aimer and radio operator in the cabin below. A 210 gallon fuel tank was located ahead of the cabin and the lower half of the nose formed a radiator compartment into which cooling air was admitted through controllable shutters.

Slightly swept, three bay, folding wings of wooden construction were fitted with large differential ailerons aerodynamically balanced by 'park bench' aerofoils on the upper pair. A high set, variable incidence tailplane gave the gunner a clear field of fire over and around a long dorsal fin and Avro circular rudder. The undercarriage was of the wide track, divided type to permit the carriage of a single heavy bomb centrally under the fuselage.

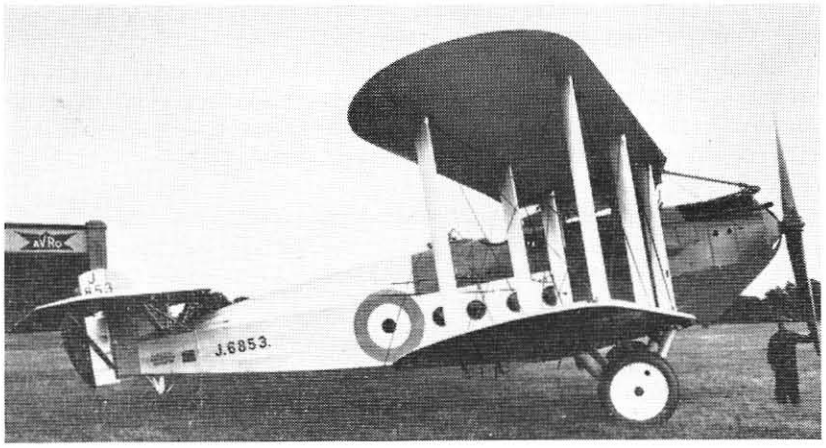
Two Aldershot I prototypes, *J6852* and *J6853*, built at Hamble for competitive trials with the de Havilland Derby, were test flown by H. J. 'Bert' Hinkler early in 1922. Trials with the first prototype evidently revealed excessive rudder loads, for the dorsal fin was removed and a new rudder with enlarged balance area fitted. This was only partially effective and the trouble

was eventually cured by increasing the length of the fuselage by some six feet. *J6852* made its debut in lengthened form in the New Types Park at the Hendon R.A.F. Display on June 24, 1922 and won the Handicap Race piloted by F/O C. E. Horrex. It then returned to Hamble for the installation of one of six prototype 1,000 h.p. Napier Cub 16 cylinder, watercooled engines which the Air Ministry had ordered in 1919 at a cost of £10,000 each. This vast power unit drove a four bladed wooden airscrew and weighed 2,450 lb. so that Chadwick had not only to design new mountings and install a gas starter, but also to strengthen the aeroplane very considerably and fit a four wheeled double undercarriage.

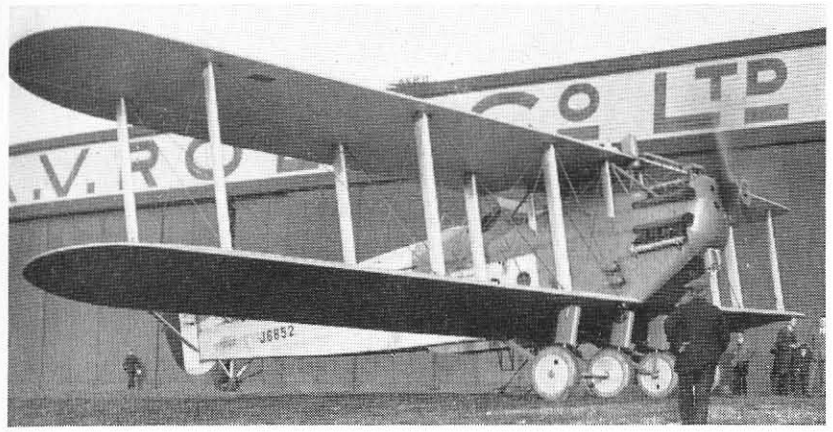
Amid considerable publicity and in the presence of Air Vice-Marshal Sir Geoffrey Salmond and Wing Cdr. Cave Brown Cave of the Air Ministry, H. T. Vane of the Napier company and A. V. Roe himself, the machine first



The first prototype Aldershot with experimental rudder and oversize horn balance. (*Photo courtesy of C. H. Barnes.*)



J6853, second prototype Aldershot in final form with lengthened fuselage.

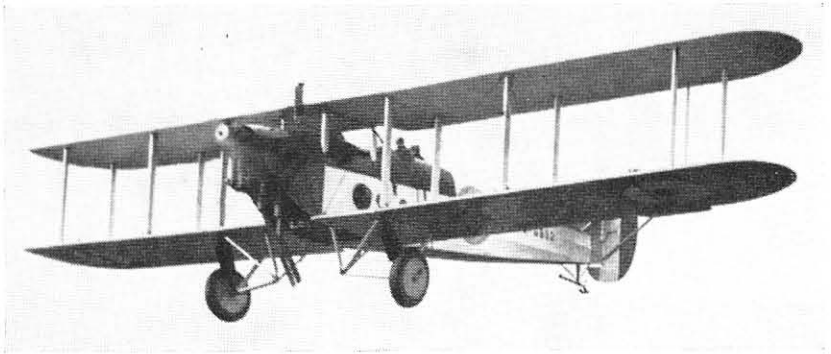


Running up the 1,000 h.p. Napier Cub in *J6852*, modified as the Aldershot II, at Hamble in December 1922.

flew at Hamble as the Aldershot II on December 15, 1922. The great machine left the ground in three seconds and after getting the feel of the controls, Hinkler threw it about and made a downwind pass at an estimated 140 m.p.h. before coming in for an impressively slow landing. It was delivered to the R.A.E., Farnborough, on January 10, 1923 and shown at the Hendon R.A.F. Display on June 30 before despatch to Hamble on July 2 to be prepared for Sweden, where it dwarfed all other aeroplanes at the Gothenburg Aero Exhibition. After its return on October 30, the Aldershot II was displayed with a Condor-engined example at the Imperial Air Conference at Croydon on November 9–12, and spent 1923 at the R.A.E. Engine Research Flight, where it was flown by F/Lt. P. W. S. Bulman.

In 1923 fifteen Condor powered, long fuselage Aldershots with strengthened multi-strut undercarriages and fuel tanks under the upper wing, were ordered under the designation Aldershot III. Armament was still the single aft-firing Lewis gun but a 2,000 lb. bomb load was carried internally. Specially re-formed at Andover on April 1, 1924, No. 99 Squadron flew the Aldershot IIIs to Bircham Newton, Norfolk, their permanent base throughout the two short years of their career. The Aldershots' exceptional stability made them particularly suitable for night flying and many of No. 99's operations were at night. They flew past in ponderous formation at the Hendon R.A.F. Display on June 27, 1925 but soon afterwards the Air Ministry abandoned its large single engined bomber policy and replaced the Aldershot IIIs with twin engined Handley Page Hyderabads.

After extended trials at Farnborough the Cub Aldershot *J6852* returned to Hamble where the standard undercarriage was replaced and the machine equipped as flying test bed for the 850 h.p. Beardmore Typhoon slow revving



J6852 in final form as the Avro 549C Aldershot IV with 850 h.p. Beardmore Typhoon engine.

six cylinder, in-line inverted engine. Cooled by a radiator below and behind, the Typhoon permitted a slim, streamlined nose with much improved view for the pilot. In this form the machine was known as the Avro 549C Aldershot IV and first flew at Hamble on January 10, 1927. It was demonstrated there by Hinkler on January 24 before leaving again for Farnborough. One standard Aldershot III was fitted experimentally with a set of steel wings and redesignated Avro 549M.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants:
(Aldershot I) One 650 h.p. Rolls-Royce Condor III
(Aldershot II) One 1,000 h.p. Napier Cub
(Aldershot III) One 650 h.p. Rolls-Royce Condor III
(Aldershot IV) One 850 h.p. Beardmore Typhoon I

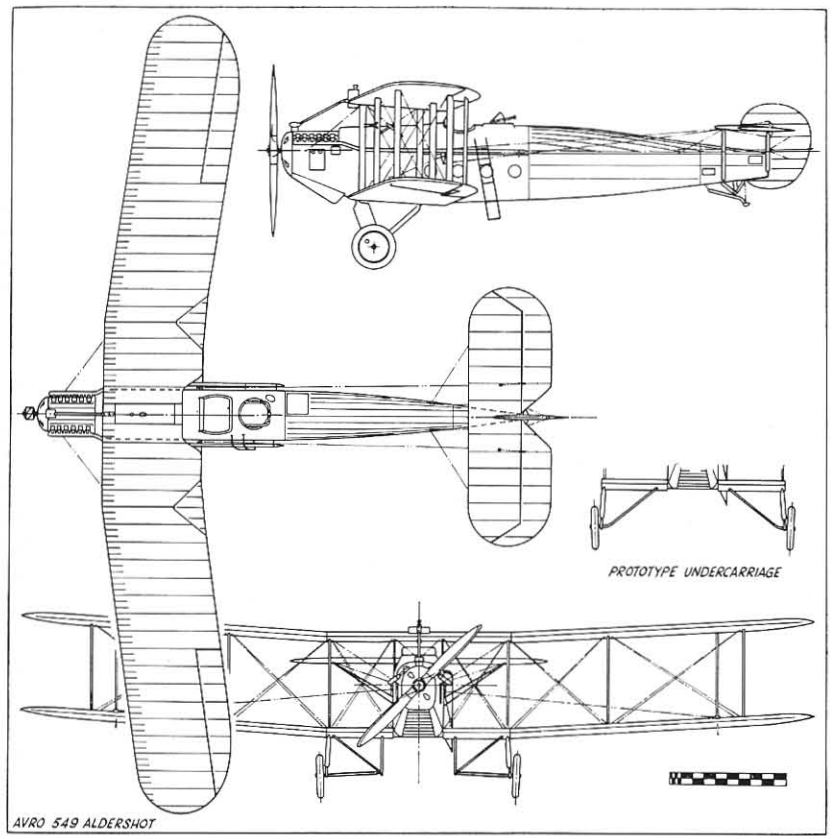
Dimensions:
Span 68 ft. 0 in. Length 45 ft. 0 in.*
Height 15 ft. 3 in. Wing area 1,064 sq. ft.
*Prototypes originally about 39 ft. 0 in.

Weights:
(Prototypes)
Tare weight 6,027 lb. All-up weight 10,764 lb.
(Aldershot III)
Tare weight 6,310 lb. All-up weight 10,950 lb.

Performance:
(Aldershot III)
Maximum speed 110 m.p.h. Cruising speed 92 m.p.h.
Ceiling 14,500 ft. Range 625 miles

Production: Prototypes *J6852* and *J6853* ordered 2.12.20 to Contract 324861/20; fifteen production Aldershot IIIs *J6942–J6956* ordered 26.1.23 to Contracts 369334/22 and 375620/22

Service Use: By No. 99 Squadron, R.A.F., at Bircham Newton, Norfolk, 1924–26





The famous test vehicle *G-EAPR* in Avro 552A form with 180 h.p. Wolseley Viper engine and 504K-type undercarriage.

Avro 552

In the course of Avro's postwar 504K modernisation programme, unused airframes *H2322* and *'23* were taken from the Manchester production line and fitted with in-line engines. The first received an 80 h.p. Renault to become the prototype Avro 548 *G-EAPQ* and the other a 90 h.p. Curtiss OX-5 as the 'one-off' Avro 545 *G-EAPR*. Comparative trials led to adoption of the Renault engine for the low powered touring variant, but the company foresaw the need for a higher powered, two seat advanced trainer which, in seaplane form, would have a better performance than the Avro 504L.

Thousands of cheap S.E.5A power units, comprising 180 h.p. Wolseley Viper watercooled engine and frontal radiator, were available from the Aircraft Disposal Co. Ltd. and a scheme to fit a unit of this type in the standard 504K received type number Avro 551 in October 1920. The trial installation was made in *G-EAPR* but a large aerofoil shape centre section tank was fitted to carry additional fuel needed by the bigger engine, full dual control was provided, and tapered ailerons fitted to improve lateral control. These considerable modifications resulted in the issue of type numbers Avro 552 to the basic seaplane and 552A to the landplane version.

For the Aerial Derby at Croydon on July 16, 1921 a Vee-type undercarriage was fitted to *'PR* which came fifth at 102·51 m.p.h. piloted by L. R. Tait-Cox. The skid-type undercarriage was then refitted but the machine was almost immediately mounted on twin wooden floats for demonstrations at Hamble which resulted in a substantial order for Avro 552 seaplanes from the Naval Air Division of the Argentine Ministry of Marine. Assembly began at Hamble in October 1921 and after test flights from Southampton Water the machines were crated for despatch to the Puerto Belgrano School at Bahia Blanca, where they were still in use in 1927.

G-EAPR was again modified early in 1922 as test vehicle for features then being incorporated in the company's new trainer, the Avro 504N. These (shown publicly when Hinkler flew the machine to Croydon on April 12, 1922) included twin 18 gallon fuel tanks under the top wing and the now

famous N-type indestructible 6 ft. track undercarriage with oil damped, rubber shock absorbers. Hinkler flew it in this form in the Croydon Races of June 3, 1922 but the early Vee-type undercarriage was later refitted for H. A. Hamersley's victory in the handicap section of the Aerial Derby at Hendon on August 6, 1923.

Following the erection of six long range, single seat Avro 552As at Camp Borden for the R.C.A.F. in 1923, a contract was awarded to Canadian Vickers Ltd. for the construction of five single seat and nine standard two seaters for forestry fire patrol. These were built at Montreal late in 1924 and a single float version *G-CYGB*, known as the Avro 552B, developed from a temporary conversion of *G-EAPR* at Hamble, was also flown.

Stripped of its wings, the slave aircraft *G-EAPR* was rebuilt at Hamble in 1927 as the Cierva C.8V (Avro 586) autogiro *G-EBTX*. Giratory experiments occupied 1928 and '29 but in 1930 the machine was acquired by L. G. Anderson who reconverted it at Hanworth to Avro 552A with skid undercarriage and untapered ailerons. Registered *G-ABGO* and equipped with underwing rollers, it was then used for banner towing by Inca Aviation Ltd. but retained the autogiro pylon attachment points on the top longerons until its demise in 1933. Only three other 'Viper Avros' existed in England, all of which were built from spares by C. B. Field at Kingswood Knoll, Surrey, for Inca in 1932. In vivid red and yellow they were a familiar sight almost everywhere but after 1935 were operated by Plane Advertising Ltd. who kept them for a short time at Barton, Manchester.



L. R. Tait-Cox on the starting line of the 1921 Aerial Derby at Croydon in *G-EAPR* fitted with Vee-type undercarriage.



G-EAPR in final fixed wing form with 504N-type undercarriage.



Root designation Avro 552 represented the original twin float concept, in which form *G-EAPR* was flown at Hamble in 1921.

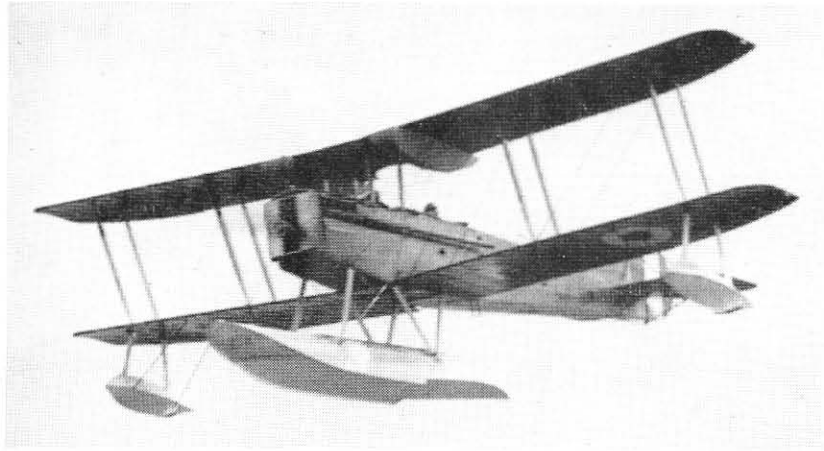
SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Canadian Vickers Ltd., Vickers Works, Maisonneuve, Montreal, Canada
C. B. Field, Kingswood Knoll, Surrey

Power Plant: One 180 h.p. Wolseley Viper

Dimensions: Span 36 ft. 0 in. Length 28 ft. 0 in.
Height 10 ft. 5 in. Wing area 330 sq. ft.

Weights: All-up weight 2,260 lb.



G-CYGB, c/n C.V.20, an Avro 552B built by Canadian Vickers Ltd. and fitted with U.O.1 type central metal float 1925. (*Canadian Vickers Ltd. Photo.*)



G-EAPR as the prototype Avro 552B with single wooden float.

Production:

(*a*) **By A. V. Roe and Co. Ltd.**

1. Prototype *G-EAPR*, ex *H2323*, C. of A. issued 11.7.23; converted 1927 to Cierva C.8V (Avro 586) *G-EBTX*; reconverted to Avro 552A as *G-ABGO* in 1931, C. of A. issued 22.4.31, owner Inca Aviation Ltd., Hanworth; crashed on take-off, Coal Aston, Sheffield 25.10.33.
2. Unspecified number of Avro 552 seaplanes, commencing *E-1*, for Argentina 1921–22.
3. Six single seat Avro 552A landplanes for the R.C.A.F. 1923.

(*b*) **By Canadian Vickers Ltd.**

G-CYFT to *'FX* inclusive, c/n C.V.10 to C.V.14.
G-CYGB to *'GJ* inclusive, c/n C.V.20 to C.V.28.

(*c*) **By C. B. Field**

Constructor's No. and Registration		*C. of A. Issued*	*Details*
nil	*G-ACAW*	20. 6.33	To Plane Advertising Ltd.; s.o.r. 9.37
12	*G-ACAX*	22.12.34	To Plane Advertising Ltd.; crashed at Sandridge, Herts. 27.3.36
9	*G-ACRP*	3. 7.34	To Plane Advertising Ltd.; s.o.r. 3.36



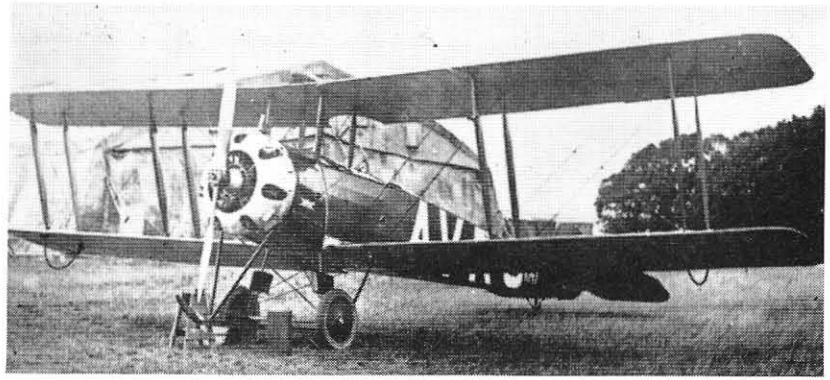
Danish Navy Avro 504N *112*, converted from Avro 504K *104* in 1928. See page 122. (*Royal Danish Air Force Photo.*)

Avro 504N

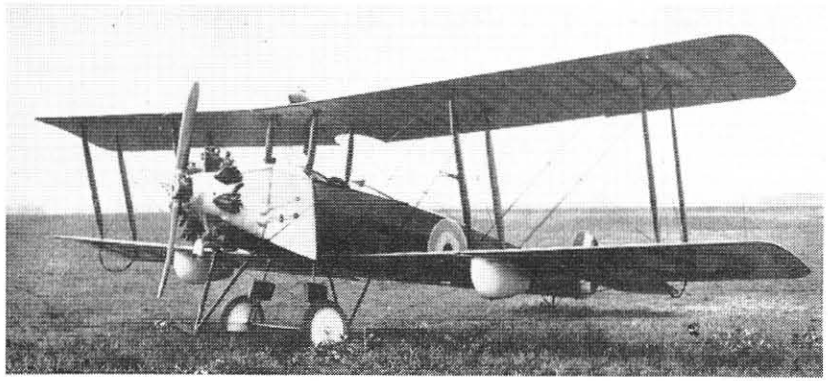
Rapid wartime development of in-line Vee and radial type engines made possible two parallel 504K postwar modernisation programmes. The first, resulting in the Avro 548 and 552, is described elsewhere, but the front fuselage of the 504K was more suited to the radial and it was an engine of this type which eventually powered the last major variant, the Avro 504N.

Early in 1919 Avro's 504K 'hack' *K-147* flew at Hamble with a 170 h.p. A.B.C. Wasp I and in the following year *D9068* flew at the R.A.E., Farnborough, with this engine as the so-called 'fireproof' Avro. The Wasp was chosen in this case as an example of an up-to-date engine to see if the fireproofing scheme, comprising aluminium/asbestos bulkhead, steel tube engine mounting, external fuel lines and tanks under the lower wing, would be effective for radial engined types of the future. Trials described in R. & M. 691 began on February 19, 1920 and continued until June 3 when the engine crankshaft failed, delaying further flights until September 28, 1922.

The Cosmos Engineering Co. Ltd. also equipped 504K *G-EADL* at Filton as test bed for their new 100 h.p. Lucifer three cylinder radial (later known as the Bristol Lucifer). Test flying was undertaken by Capt. Norman Macmillan but ended abruptly when *'DL* broke its back in a difficult forced landing at Kingswood through engine failure in January 1920. The replacement aircraft *G-EAJB*, on loan from Avro, incorporated the airframe modifications necessary to keep pace with more efficient and powerful engines. The skid-type undercarriage remained, but the famous elastic shock absorbers gave place to a new semi-oleo type in which half the travel was taken by an oil dashpot before picking up rubber-in-compression. Tapered ailerons were also



K-147, c/n A.T.C.14, fitted experimentally with a 170 h.p. A.B.C. Wasp I radial engine.



D9068 with Wasp I and fireproof engine installation.

fitted to lighten lateral control and harmonise them with the near-perfect rudder and elevators.

Early in 1922 the Hamble works fitted *G-EADA* (one of the old Avro Transport Company 504Ks) with a Bristol Lucifer, and modified two Service machines *E9265* and *'66* to take the higher powered 150 h.p. Armstrong Siddeley Lynx seven cylinder radial, but all three retained the skid undercarriage. Hinkler flew both Lynx Avros to Croydon for demonstration in May 1922 and *'DA* flew in the first King's Cup Race there on September 8, 1922. Piloted by Maj. C. R. Carr it forced landed at Halifax. Although often referred to as the 504N prototypes, they were, more accurately, a first intermediate type. Nor were they the only examples. Years later in 1928 Phillips and Powis Ltd., Woodley, fitted 504K *G-EBWO* with a 100 h.p. Anzani radial and tapered ailerons for private owner Dr. M. C. Wall and in 1932

Armstrong Siddeley Mongoose engines were installed in 504Ks by Air Travel Ltd., Penhurst. The last example was *G-ABVC* flown by H. C. Chater with a Lucifer at Lympne in 1935.

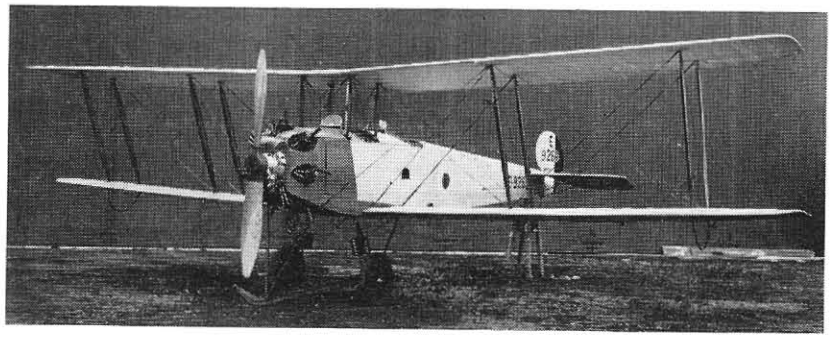
A slightly more advanced interim type was a dual control trainer version with oleo sprung skid-type undercarriage and Lynx engine. Four of these, *G-EBHC*, *'HD*, *'HE* and *'HT* were supplied to Armstrong Whitworth Ltd. in 1923 for use at the A. W. Reserve Flying School at Whitley. In 1931 the survivors, *G-EBHD* and *'HE*, were sold for joyriding to R. O. Roch (Modern Airways Ltd.) and L. J. Rimmer (North British Aviation Co. Ltd.) respectively, the latter being reconverted to Avro 504K (130 h.p. Clerget).



Avro 504K *G-EADL* used by the Cosmos Engineering Co. Ltd. to airtest their 100 h.p. Lucifer radial at Filton 1920.



The second Lucifer test bed *G-EAJB*, with semi oleo skid-type undercarriage. (*Bristol Photo.*)



E9265, first of the two 150 h.p. Armstrong Siddeley Lynx engined interim prototypes.



Avro 504K *G-EBWO* "Bluey" of the Phillips and Powis Flying School with 100 h.p. Anzani radial.

Work was also in hand at Hamble on the now-famous N-type undercarriage. This consisted of two main legs coupled to the axle, which in turn was hinged by two horizontal tubes to the bases of two tubular steel Vees behind, and in line with, the main legs. Shock absorbers were of the semi-oleo type and the prototype undercarriage was fitted to *G-EADA* for participation in the 1923 Grosvenor Trophy Race at Lympne. Piloted by H. A. Hamersley, it came fourth at an average speed of 71·2 m.p.h. and afterwards went to Farnborough for undercarriage trials.

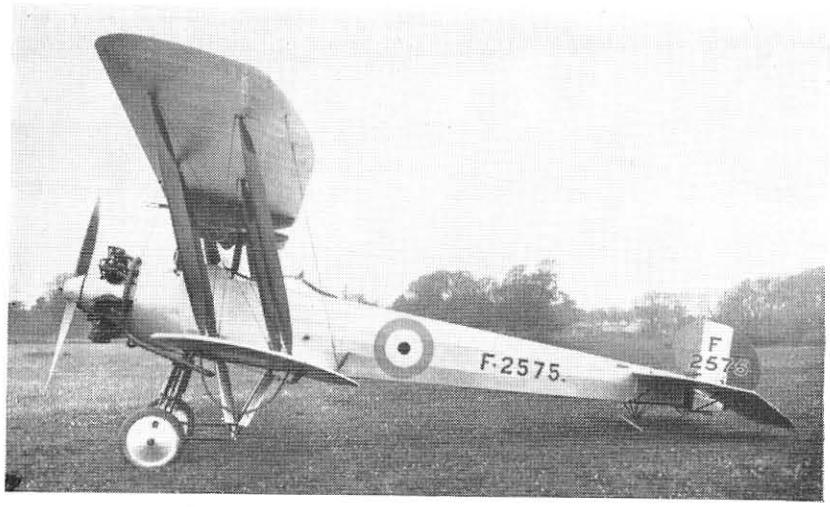
As a result of further Lucifer engine tests at Filton and Croydon with Avro 504K *G-EBFB*, the Aircraft Disposal Co. Ltd. produced four 504Ns with this engine (*E444*, *H2512*, *H2562* and *F8841*) for export to Argentina. These had standard 504K mainplanes and represented the penultimate stage in 504N development. The final product emerged at Hamble in the following year when

the Air Ministry ordered two trainer prototypes with alternative power plants. Both were conversions of new airframes caught in the Manchester factory when contracts were cancelled in 1918, the first *J733* having a Lucifer and the other *J750* the new 180 h.p. Lynx. These machines had all the final airframe modifications, viz. cutaway centre sections and wing roots to improve forward and upward visibility from both cockpits, 18 gallon fuel tanks under each upper mainplane, adjustable tailplanes and additional stringers to round out the fuselage sides. Martlesham trials resulted in the adoption of the Lynx powered versions as the R.A.F.'s new standard trainer and large scale production began in Manchester. Refinements embodied in a special lightweight aircraft *F2575*, consisting of streamlined engine cowlings with spinner, slimmer fuselage without top decking, and elevator controls re-routed externally (as on the Avro Baby and 548 prototype) were not adopted. This machine later formed the firm's exhibit at the Third Czechoslovakia International Aeronautical Exhibition at Prague May 31–June 9, 1924.

Production Avro 504Ns to Specification 6/30 commenced with *J8496* in 1925, and 598 were built, ending *K2423* in March 1932. Early versions had wooden fuselages and tapered ailerons but later models had fuselages of welded steel tube and rectangular Frise-type ailerons. Government economies kept procurement below minimum requirements but deficiencies were met by converting nearly 100 exceedingly ancient 504Ks to N standard. One of these, *D6382*, served with No. 2 F.T.S. Digby, and credit must be given to this unit for popularising the crazy flying act first seen at the 1930 Hendon R.A.F. Display. One of the pilots on that occasion was F/O Frank Whittle who later perfected jet propulsion. Similar exhibitions of hilarity in 504Ns were among



J733, first true Avro 504N prototype, with Lucifer engine and N-type undercarriage.



Trials aircraft *F2575* with Lynx engine, streamlined front fuselage, and external elevator control circuit.

the chief Display attractions up to 1933. In a more serious vein, the machine was historically important as the first R.A.F. instrument flying trainer. For this purpose six aircraft of 'E' Flight, C.F.S., Wittering, were rigged with one degree less dihedral to reduce their inherent stability and fitted with blind flying hoods and Reid and Sigrist turn and bank indicators.

No history of the 504N would be complete without mention of the famous Hamble-built 'hack' *G-EBKQ*, Hinkler's mount in the 1925 King's Cup Race. In March 1926 '*KQ* was fitted with thick biconvex R.A.F. 30 section mainplanes housing the fuel tanks, Frise ailerons on the bottom plane only, simplified wing and undercarriage strutting under the designation Avro 582. It appeared thus in March 1927 at the Norfolk and Norwich Aero Club meeting; at Bournemouth when H. A. Hamersley raced it during the Easter Meeting; and on July 3 when Alan Goodfellow flew the Bishop of Willochra, South Australia, on an urgent Sunday journey from Woodford to Croydon. At a later date '*KQ* was fitted with long exhausts linked under the tailplane as on skywriting S.E.5As, and later still reverted to standard 504N configuration. It then went to Filton as a more suitable test bed for the new 210 h.p. Bristol Titan than the venerable *G-EAJB*. On its return to Hamble in 1930 the machine was equipped with twin metal floats and Mongoose engine as a penguin trainer for Air Service Training Ltd. Despite the low power it could be coaxed off the water under favourable conditions by experienced instructors and was often in the air over Southampton Water.

The Avro 504N had a considerable association with marine aviation, a 'one-off' conversion *J7301* having flown at Gosport and at R.A.E.,

Farnborough, with the primitive claw-type arrester gear under the axle in July 1924. Unarrested deck landing trials were made later on an aircraft carrier at sea by *K1813*.

A. V. Roe and Co. Ltd. also delivered 504Ns to Belgium, Brazil, Chile, Denmark, Greece, Peru, South Africa and Sweden. Siam also adopted the 504N after comparative trials with a Consolidated PT-1. A number were equipped with float undercarriages and dorsal fins under the designation Avro 504O, those for Chile being unique in retaining the seaplane fin during test flights on wheels. Floats were Vee-bottomed to make shock absorbers unnecessary and were of two types, either boat-built and double skinned with mahogany, or of duralumin. The Danish Navy had six Avro 504Ns, one of which, *107*, was delivered from Avro on September 28, 1925 while two others were local 504K conversions (one became civil in 1936) and the remaining three were built under licence by Orlogsvaerftet (Danish Naval Shipyard). One of the latter, *110*, is preserved in the Arsenal Museum at Copenhagen. Licence-built 504Ns were produced by SABCA in Belgium and by the Royal Thai Aeronautical Service Workshops. During 1926–28 Canadian Vickers Ltd. converted at least 14 R.C.A.F. Avro 504Ks to N standard, and fitted some with ski undercarriages. They also built one example of a single float seaplane powered by a 200 h.p. Wright Whirlwind J-4, and a number of standard machines for the R.C.A.F., one of which, *G-CYHE*, flew with a Hamilton Standard variable pitch airscrew.

In 1920 the Japanese Yokosuka Naval Arsenal produced a navalised adaptation of the Avro 504K known as the Yokosuka K1Y1. This was developed as the K2Y1 with Vee undercarriage and 130 h.p. Armstrong Siddeley Mongoose in 1928; and as the K2Y2 Type 3 with 130 h.p. Gasden Jimpu radial in 1929. Production, initially by the Watanabe Iron Works, was continued by the Kyushu Aircraft Company and others until 1940.

When the Avro 504N was declared obsolete by the R.A.F. in 1933, some were reduced to instructional airframes and others were sold to civilian operators. With the exception of *G-ACZC*, flown privately from a field at Marlborough by the Earl of Cardigan, they were employed mainly for joy-riding or towing advertisement banners. The first three civil conversions, made by F. J. V. Holmes' new firm Air Travel Ltd. at Penshurst, Kent, were merely 504Ks with 150 h.p. Armstrong Siddeley Mongoose IIIA radials. Air Travel Ltd. later moved to Gatwick and there overhauled a number of ex R.A.F. 504Ns which toured with Sir Alan Cobham's National Aviation Day Displays and British Hospitals Air Pageants Ltd. 1934–35, and finally with C. W. A. Scott's Air Display in 1936. A later conversion turned the wheel full circle when C. B. Field revived the original 504N alternative by fitting a 115 h.p. Bristol Lucifer IV into *G-AEAA* to private order at Kingswood Knoll, Surrey.

With one tank removed and operating on reduced fuel load, the low powered Mongoose 504N was an extremely economical aeroplane for short pleasure flights. Several of the Lynx engined variety, equipped either with



The famous *G-EBKQ* in Avro 582 configuration with R.A.F.30 section mainplanes at Bournemouth in April 1927.



G-EBKQ at Filton in 1928 as test bed for the 210 h.p. Bristol Titan radial. (*Bristol Photo.*)



G-EBKQ/K-8 taking off opposite the Hamble slipway after reconstruction in 1930 as Air Service Training's Mongoose engined Avro 504O with metal floats. (*'Flight' Photo 12327.*)

under-wing rollers or a quick release gear under the tail for banner towing, infested British skies for several years, exhorting the masses to buy well-known brands of almost everything. They were operated by Aerial Sites Ltd., Hanworth (2 aircraft); Plane Advertising Ltd., Heston (4); Publicity Planes Ltd., Hanworth (2); and Air Publicity Ltd. (8). Three which later found their way into club use were *G-ACOM* (Herts and Essex Aero Club, Broxbourne); *G-ADBD* (Aero 8 Club, Ashingdon, Essex); and *G-AECS* (Bournemouth Flying School, Christchurch).

The brothers L. G. and L. J. Anderson of Hanworth were responsible for a number of conversions including *G-ADBO–'BS* for joyriding in 1935 and two others, *G-AECR* and *'CS*, (Mongoose powered), toured with Irish Air Displays Ltd. in 1937. An attempt to tow banners in Ireland with Plane Advertising Ltd.'s *G-AEIJ* ended in the Irish Sea on January 21, 1937. On July 24 of that year Capt. Percival Phillips (managing director of Air Publicity Ltd. and founder of the Cornwall Aviation Co. Ltd. in 504K days), astonished the whole flying fraternity by winning the Devon Air Race at Exeter. With his wife as passenger and flying banner towing 504N *G-ADEV*, he completed the course at the incredible average speed of 103 m.p.h. He did even better in the Thanet Air Race at Ramsgate on August 21 and averaged 103·75 m.p.h., but the handicappers had his measure and *'EV* came only fourth.

In 1940 seven civil Avro 504Ns were recalled to duty by the R.A.F. Three formed the Special Duty Flight at Christchurch, whence they towed gliders 40 miles out to sea for experiments in radar detection of wooden aircraft. Three others were used at the R.A.E., Farnborough, and at the Development Unit of the Central Landing Establishment at Ringway to develop glider-towing techniques for the future Airborne Forces.



A Chilean Naval Air Service Avro 504O, with dorsal fin, mounted on a land undercarriage for test flying at Hamble 1929.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Canadian Vickers Ltd., Vickers Works, Maisonneuve, Montreal, Canada
Société Anonyme Belge de Constructions Aéronautiques, 1362 Chausée de Haecht, Haren, Brussels, Belgium
Orlogsvaerftet (Royal Danish Shipyard), Copenhagen, Denmark
Royal Thai Aeronautical Service Workshops, Don Muang, Bangkok, Siam

Power Plants: One 100 h.p. Bristol Lucifer
One 115 h.p. Bristol Lucifer IV
One 150 h.p. Armstrong Siddeley Mongoose IIIA
One 150 h.p. Armstrong Siddeley Lynx
One 180 h.p. Armstrong Siddeley Lynx IVC
One 200 h.p. Wright Whirlwind J-4

Dimensions, Weights and Performances:

	Avro 504N			Avro 504O	
Engine	Lynx I	Lynx IVC	Mongoose IIIA	Lynx IVC	Lynx IVC
Floats	—	—	—	wooden	metal
Span	36 ft. 0 in.	36 ft. 0 in.	36 ft. 0 in.	36 ft. 0 in.	36 ft. 0 in.
Length	28 ft. 5½ in.	28 ft. 11 in.	28 ft. 11 in.	31 ft. 7 in.	30 ft. 0 in.
Height	10 ft. 10 in.	10 ft. 10 in.	10 ft. 10 in.*	11 ft. 10 in.	11 ft. 10 in.
Wing area	320 sq. ft.	320 sq. ft.	320 sq. ft.	320 sq. ft.	320 sq. ft.
Tare weight	1,555 lb.**	1,584 lb.	1,392 lb.*	1,973 lb.	1,827 lb.
All-up weight	2,166 lb.**	2,240 lb.	2,260 lb.	2,663 lb.	2,483 lb.
Maximum speed	100 m.p.h.**	100 m.p.h.	90 m.p.h.	96 m.p.h.	97 m.p.h.
Cruising speed	85 m.p.h.**	85 m.p.h.	80 m.p.h.	80 m.p.h.	80 m.p.h.
Initial climb	800 ft./min.**	770 ft./min.	625 ft./min.	610 ft./min.	650 ft./min.
Ceiling	19,400 ft.**	17,000 ft.	14,700 ft.	13,500 ft.	14,500 ft.
Range	255 miles	255 miles	320 miles	240 miles	240 miles

*With Lucifer IV engine, 10 ft. 5 in. and 1,518 lb. respectively.
***F2575* 1,456 lb., 2,066 lb., 95 m.p.h., 75 m.p.h., 750 ft./min., 16,000 ft. respectively.

Production:

(*a*) Development aircraft

Constructor's No. (or R.A.F. serial) and Registration		*C. of A. Issued*	*Details*
A.T.C.14	*K-147*	nil	Wasp I; converted 1920 to Avro 548
D9068	—	nil	Wasp I; 'fireproof' Avro at R.A.E. 1920–22
E4348	*G-EADL*	nil	Lucifer; crashed at Kingswood 1.20
H2598	*G-EAJB*	20. 8.19	Lucifer; converted 1927 to Avro 548
E4221	*G-EADA*	nil	Lucifer; s.o.r. 1924
H2518	*G-EBFB*	nil	Lucifer; s.o.r. 1.25
5104	*G-EBKQ*	2. 7.25	Lynx IVC; first flown at Hamble 2.7.25; 3.27 to Avro 582; Titan test bed 1928; to Air Service Training Ltd., Hamble as Avro 504O (Mongoose), C. of A. reissued 14.6.30; sometime with Class B marking *K-8*; s.o.r. 11.35
R3/CN/126	*G-EBVY*	1. 2.28	Lynx IVC; 11.32 L. G. Anderson, Hanworth; crashed at Tooting, London 30.1.35

(*b*) Prototype aircraft

E9265, E9266, F2575, J733, J750. Also *J7301* to Contract No. 492529/24

(*c*) Interim aircraft for Armstrong Whitworth

Constructor's No. and Registration	*C. of A. issued*	*Details*
R3/LY/10331 *G-EBHC*	nil	Registered 20.7.23, crashed 3.8.23
R3/LY/10348 *G-EBHD*	1. 8.24	1.31 to R. O. Roch, Hanworth; 3.32 Modern Airways Ltd.; s.o.r. 9.36
R3/LY/10365 *G-EBHE*	12.12.23	Converted 1932 to Avro 504K (see page 181)
R3/LY/10382 *G-EBHT*	14. 2.24	Replacement for *'HC*; 3.32 Modern Airways Ltd.; s.o.r. 12.32

(*d*) R.A.F. production batches

Requisitioned	Quantity	Serials	Requisitioned	Quantity	Serials
March 1927	100	*J8496–J8595*	September 1929	25	*K1038–K1062*
March 1927	100	*J8676–J8775*	1930	13	*K1241–K1253*
December 1927	50	*J8975–J9024*	1931	26	*K1798–K1823*
March 1928	20	*J9415–J9434*	1932	35	*K1956–K1990*
June 1928	40	*J9253–J9292*	1933	78	*K2346–K2423*
September 1929	25	*J9683–J9707*			

(*e*) R.A.F. conversions from Avro 504K

Seventy-eight aircraft including *D6382, D6388, E430, E3327, E3460, E8813, E9408, F2269, F2286, F2588, F8713, F8812, F9705, H2618, H2962, H2972, H3105, H5196, H5199, H7534, H9821, H9866, H9870.*

(*f*) Export orders

Belgian Air Force: Avro 504Ns c/n 373–382, Cs. of A. issued 14.12.29; c/n 480–484, Cs. of A. issued 19.1.31; c/n 492–493, Cs. of A. issued 14.3.31

Brazilian Naval Air Service: Avro 504N/504Os c/n 439–442 delivered 5.30

Chilean Naval Air Service: Avro 504Os c/n 355–360, serial numbers *82–87*, completed 17.8.29, based at El Bosque

Danish Navy: Six Avro 504Ns, including five produced in Denmark, locally designated L.B.1 (Land Biplane 1)

Constructor's No. and Serial*		*On Charge*	*Details*
—	*107*	28. 9.25	Crashed off Copenhagen 9.8.26
43	*108*	11. 3.26	Crashed at Ringsted 16.5.29
49	*109*	2. 5.27	Crashed at Ringsted 30.5.29
50	*110*	2. 5.27	To the Arsenal Museum, Copenhagen 1935
—	*111*	1927	ex 504K *106*, crashed at Avnø 20.6.28
—	*112*	1929	ex 504K *104*, s.o.c. 13.7.36, sold as *OY-DEL*, seized by Germans 1940

*Orlogsvaerftet constructor's numbers.



The single float seaplane version *G-CYGK*, c/n C.V.29, with 200 h.p. Wright Whirlwind J-4, built by Canadian Vickers Ltd. 1926. (*R.C.A.F. Photo.*)

Royal Hellenic Naval Air Service: Six Avro 504N/504Os were supplied in 1925 to Works Order 7787 for training schools at Tatoi and Phaleron Bay, a few of which were still in service with the Royal Hellenic Air Force in 1940. Original serials around and about *E-14* and *E-15*

Japan: One Avro 504O supplied 1.27 to Works Order 8430

South African Air Force: Avro 504Ns were supplied as 504K replacements in 1927

Royal Thai Air Force: Twenty Avro 504Ns, c/n 390–409 supplied 3.30

Royal Swedish Air Force: One Avro 504N, serial *64*, Flygvapnet designation Sk 3A, delivered at Malmslätt for evaluation 28.4.26, crashed on take-off 11.4.27

(*g*) Conversion and construction by Canadian Vickers Ltd.

G-CYCX, *'FY*, *'FZ* (Lynx); *G-CYGK* (c/n C.V.29) single float, Wright Whirlwind J-4; *G-CYHE* with Hamilton Standard variable pitch airscrew; R.C.A.F. *2* (ex 504K *G-CYAQ*), *6*, *9*, *14* and *15*; R.C.A.F. *32–43* (c/n C.V.59–C.V.70) built 1927; R.C.A.F. *44–49* and *51*

(*h*) Built under licence by SABCA

SABCA 504N Nos. *1–31*, the last 10 of which were ordered 10.37

R.A.F. Service Use: (with specimen serials)

Central Flying School, Upavon, *H5185*, *H9870*, *J8548*, *K1042*, *'50*, *K1244*, *'46*, *K1963*, *'84*, *K2346*, *'74*, *'75*, *'77*, *'78*, *'81*; No. 1 F.T.S., Netheravon, *J8745*, *'72*, *J9012*, *K1051*, *K1818*, *K2419*, *'23*; No. 2 F.T.S., Digby, *D6382*, *F8812*, *H9821*, *'66*, *J9018*, *J9265*, *J9688*, *'90*, *K1815*; No. 3 F.T.S., Grantham, *E3327*, *J8709*, *'53*, *'54*, *'74*, *J9687*, *K1056*, *'59*, *K1822*; No. 4 F.T.S., Abu Sueir, *F2286*, *F9705*, *H3105*, *J8695*, *J8715*, *J8975*, *'77*, *'90*, *'91*, *K2359*, *'84*, *'85*, *'89*, *'91*, *'99*, *K2405*; No. 5 F.T.S., Sealand, *H2618*, *H3460*, *J8518*, *'24*, *'33*, *'35*,

J8677, *J9007*, *J9428*, *'31*, *K1046*, *'47*, *'53*, *K1975*, *'90*, *K2347*, *'49*, *'51*, *'54*; No. 23 E.R.F.T.S., Rochester, *K2400*, *'01*, *'08*, *'11*, *'17*, *'19*, *'20*, *'23*; Oxford University Air Sqn., *K1243*. *'47*, *K1802*, *'12*, *'18*, *'19*, *K1962*, *K2367*, *'71*; Cambridge University Air Sqn., *K1241*, *K1813*, *'15*, *'43*, *K1961*, *'66*, *K2367*; R.A.F. College, Cranwell, *H9826*, *J8709*, *J9693*, *K1808*, *K1966*, *'87*; No. 7 Sqn., *K1963*, *'68*, *'69*; No. 24 Sqn.; Station Flight, Duxford, *J8758*; No. 500 Sqn. A.A.F., *K1811*, *K2407*, *'12*; No. 501 Sqn., *J8689*; No. 502 Sqn., *J8738*; No. 601 Sqn., *J8504*, *'05*, *K1971*; No. 602 Sqn., *K1982*; No. 603 Sqn., *K1822*, *K2417*; No. 604 Sqn., *K1043*; No. 607 Sqn., *K2364*; No. 1 A.A.S., *K2365*

British civil conversions (radial engined Avro 504Ks):

G-ABVC/*F8834*, Lucifer, C. of A. 9.6.33, H. C. Chater, Lympne, s.o.r. 11.45; *G-ABVH*/*J8372* (C. of A. 8.4.32, s.o.r. 12.46), *G-ABVY*/*H2524* (C. of A. 21.5.32, s.o.r. 10.36) and *G-ACCX* (C. of A. 8.4.33, wrecked at Leighton Buzzard 19.6.34) all Mongoose IIIA, Air Travel Ltd., Penshurst, Kent



Avro 504N *G-ACCX* of Air Travel Ltd., a special conversion with 150 h.p. Armstrong Siddeley Mongoose IIIA engine and 504K type undercarriage. (*Hunting Aerosurveys Photo.*)

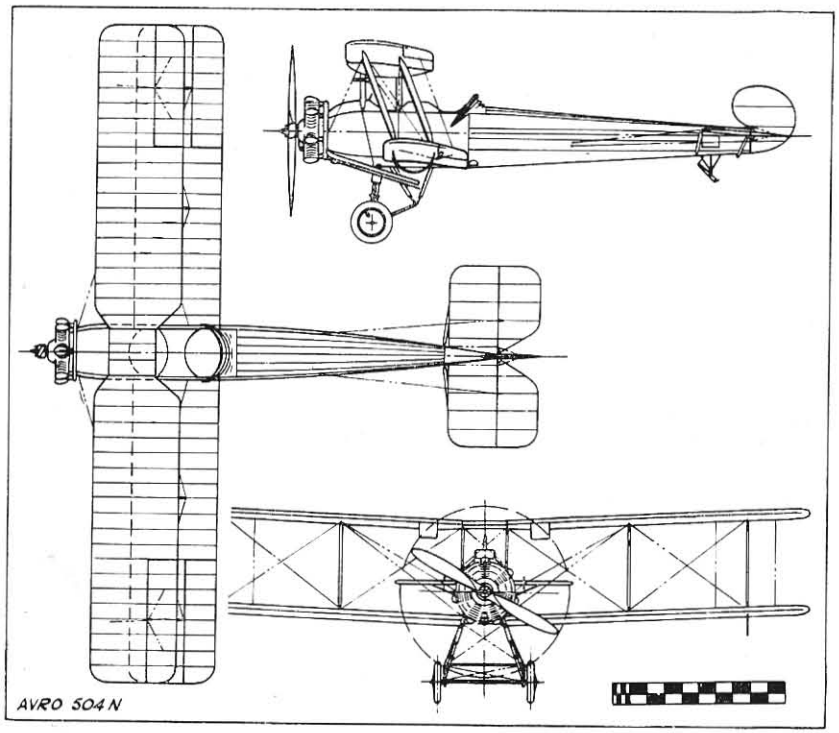
British civil conversions 1934–36 (Avro 504N):

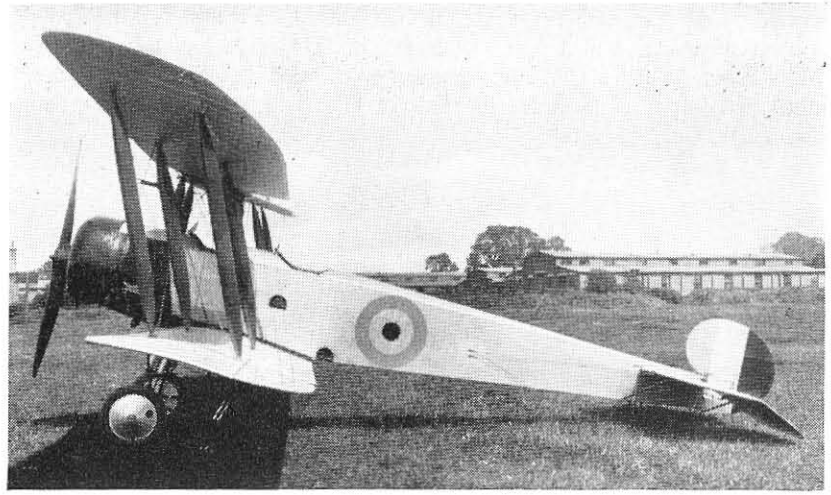
G-ACLV/*J8573* Air Travel Ltd.; *G-ACNV*/*K1808* Air Pageants Ltd.; *G-ACOD*/*F8713* Air Travel Ltd. (air collision with Westland Wessex *G-ADFZ* over Blackpool 7.9.35); *G-ACOK*/*F2588** National Aviation Day (crashed at Rhyl 14.8.38); *G-ACOM*/*E430** Air Travel Ltd.; *G-ACPV*/*K1250* Aerial Sites Ltd., to Publicity Planes Ltd. 3.38 (impressed 1.41 as *BV209*); *G-ACRE*/*E9408* Air Publicity Ltd. (crashed at Gamlingay, Cambs. 13.2.38); *G-ACRS*/*K1802* National Aviation Day (crashed at Cove, Hants. 30.6.34); *G-ACZC* Earl of Cardigan (impressed 6.40 as *AX854*/*2453M*); *G-ADBD*/*K1245** National Aviation Day; *G-ADBM*/*K1055* Air Publicity Ltd. (impressed 6.40 as *AX871*, crashed at Hawkinge 1.8.40); *G-ADBO*/*K2354* Air Publicity Ltd.; *G-ADBP*/*K2353* Air Publicity Ltd. (impressed 6.40 as *AX874*); *G-ADBR*/*K1819* Air Publicity Ltd.; *G-ADBS*/*K1251** L. G. Anderson (crashed at Bodmin, Cornwall 16.8.35); *G-ADDA*/*K1810* Air Publicity Ltd.; *G-ADEI*/*E3460* H. B. G. Micklemore (crashed at Hanworth

16.5.39); *G-ADET/J8533* Air Publicity Ltd. (impressed 6.40 as *AX875*); *G-ADEV/H5199* Air Publicity Ltd. (impressed 9.40 as *BK892/3118M*); *G-ADFW/K1061** Lincolnshire Flying Services Ltd., Louth; *G-AEAA*, c/n 14**, F. C. J. Allen, Ford; *G-AECR/K2396** L. J. Anderson (sold abroad 3.38); *G-AECS/J8548* L. J. Anderson; *G-AEDD/K1823* Plane Advertising Ltd. (crashed 13.3.39); *G-AEGW/J9702** L. J. Rimmer (burned at Hooton 8.7.40); *G-AEIJ/J8507* Plane Advertising Ltd. (lost in the Irish Sea 21.1.37); *G-AEMP/J9017* Plane Advertising Ltd. (impressed 1.41 as *BV208*); *G-AFRM/K1964* Martin Hearn Ltd. (burned at Hooton 8.7.40)

*150 h.p. Mongoose IIIA. **115 h.p. Bristol Lucifer IV (C. B. Field conversion).

Note: Only the principal operator of each aircraft is given.





The Avro 504K Mk. II prototype. (100 h.p. Gnome Monosoupape.)

Avro 504K Mk. II

In 1924 the Hamble works produced a hybrid trainer known as the Avro 504K Mk. II and consisting of a flat sided 504K fuselage married to 504N-type undercarriage and mainplanes. The reasons underlying the creation of this strange variant were twofold, firstly to enable air forces of the smaller nations to modernise their 504K trainers using Avro-built conversion kits, or alternatively to provide low price 504N equivalents powered by cheap surplus 100 h.p. Gnome Monosoupape rotaries. The only recorded conversions at that time were made in the Mexican Air Force workshops at Balbuena, serials round and about *53*.

The Avro 504K Mk. II was shelved but in 1935 four ex R.A.F. Avro 504N airframes, long stored at Croydon, were brought out and converted into joyriding three seaters with 130 h.p. Clerget engines. They were therefore equivalent to the Avro 504K Mk. II of 11 years previously, differing from the prototype only in the type of engine, rounded sides, untapered ailerons, absence of wing tip skids and fuel tankage. The 1935 machines had one 18 gallon tank under the port upper wing root in the manner of the Mongoose-powered civil Avro 504N instead of the slim centre section tank of the prototype.

They were registered *G-ADGB*, *'GC*, *'GM* and *'GN* but work on *G-ADGC* was not completed. The other three endured one season's joyriding at Camber Sands, Sussex, with Zenith Airways, although *'GM* and *'GN* were nominally

owned by Aircraft and Autos Ltd. and Aviation Commerce Ltd. of Croydon respectively. None flew after 1935 except *'GM* which was acquired by Brooklands Aviation Ltd. for joyriding at Shoreham. In the winter it was employed on school work at Brooklands and was destroyed there in a hangar fire on October 24, 1936.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester and Hamble Aerodrome, near Southampton, Hants.

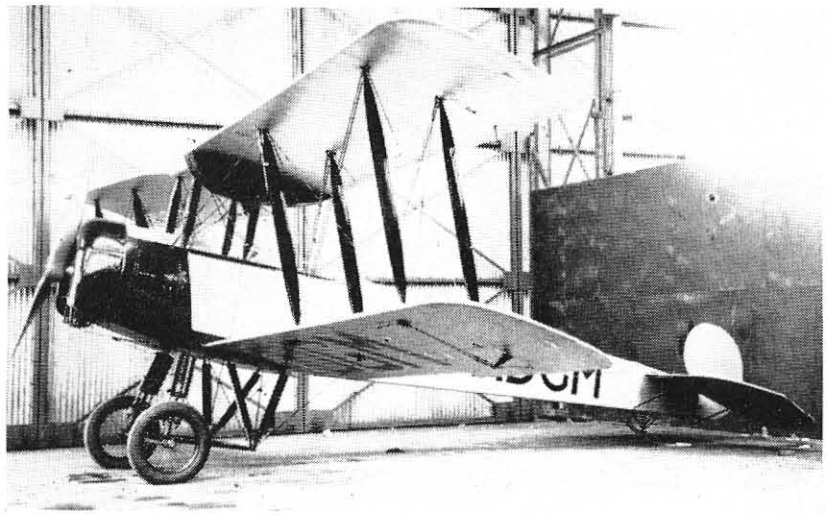
Power Plants: One 100 h.p. Gnome Monosoupape
One 130 h.p. Clerget

Dimensions: Span 36 ft. 0 in. Length 28 ft. 6 in.
Height 10 ft. 11 in. Wing area 320 sq. ft.

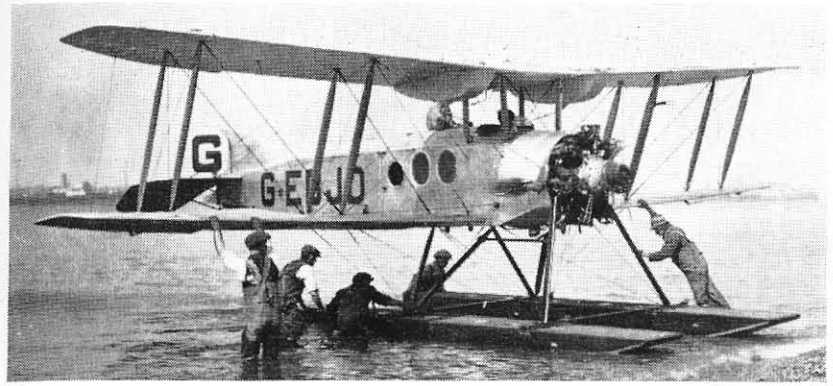
Weights: All-up weight 2,155 lb.

Production:

R.A.F. Serial and Registration		*C. of A. Issued*	*Details*
—	—	—	Prototype, built Hamble 1924
J8758	*G-ADGB*	19. 6.35	Zenith Airways, Camber; s.o.r. 6.36
J9689	*G-ADGC*	nil	Zenith Airways, Camber; s.o.r. 1.36
K1962	*G-ADGM*	11. 7.35	Aircraft and Autos Ltd.; 6.36 Brooklands Aviation Ltd.; destroyed by fire at Brooklands 24.10.36
H2962	*G-ADGN*	10. 8.35	Aviation Commerce Ltd.; s.o.r. 3.38



G-ADGM, one of the 130 h.p. Clerget conversions made at Croydon in 1935. (*E. J. Riding Photo.*)



The Avro 504Q *G-EBJD* being launched at Hamble in 1924. (*Photo courtesy of J. C. C. Taylor.*)

Avro 504Q

Designation Avro 504P was allotted to a proposed variant of the 504N having two seats side by side. Although this was never built, preparatory work for widening the fuselage undoubtedly assisted in the construction of the Avro 504Q, a special three seat seaplane assembled at Hamble in 1924 for the Oxford University Arctic Expedition. Registered *G-EBJD* and powered by a 160 h.p. Armstrong Siddeley Lynx, the 504Q somewhat resembled the Avro 546 with open pilot's cockpit ahead of a glazed cabin, and a large dorsal fin at the rear.

Entry to the cabin was by a door in the starboard side and there was a sliding hatch in the roof through which the navigator could work in the open or pick up moorings. A Norwegian sledge was carried under the rear decking and a close fitting engine cowl was stowed aboard in readiness for flying in sub-zero temperatures. In addition to the usual external 504N-type fuel tanks a large streamlined tank was fitted in the centre section and long wooden, single-step floats, strengthened to act as skis for landing on snow, made a tail float unnecessary.

The Avro 504Q was test flown from Southampton Water by H. J. Hinkler before despatch to Newcastle for shipment to Spitzbergen in the s.s. *Polarbjørn*. With it went G. (later Sir George) Binney leading the expedition, A. G. B. Ellis first pilot, J. C. C. Taylor pilot and engineer, and Capt. (later Sir Frederick) Tymms as observer, who, assisted by other members of the Expedition, erected the machine in four days and nights at an abandoned whaling base at Green Harbour, well within the Arctic Circle. Piloted by Ellis and carrying Binney as passenger, the 504Q left Green Harbour for Liefde Bay on July 15 but was forced down on the sea by engine failure. It was salvaged after a battle with heavy seas lasting 18 hours and taken to

Liefde Bay for complete engine overhaul, but during later operations the long suffering undercarriage collapsed when the aircraft failed to clear the land on take-off from Treurenberg Bay. Even then repairs were somehow completed in ten days despite the primitive working conditions. In the course of a survey flight over North East Land (an island lying north east of Spitzbergen) in appalling flying conditions on August 8, 1924 *G-EBJD* reached latitude 80 degrees 15 minutes, the farthest north ever reached by an aeroplane up to that time. At the conclusion of the Expedition's work the Lynx engine was removed for return to the United Kingdom but the airframe was left at Liefde Bay to test the effect of prolonged Arctic weathering on fabric covered wooden structures. When rediscovered by a later expedition in 1932 it was still in reasonable condition but had been partly eaten by polar bears.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plant: One 160 h.p. Armstrong Siddeley Lynx serial number A.S.17

Dimensions: Similar to Avro 504N

Weights: All-up weight 3,232 lb.

Performance: Maximum speed 85 m.p.h. Cruising speed 63 m.p.h.

Production: One aircraft only, *G-EBJD*, c/n 5103, registered 12.6.24 to the Oxford University Arctic Expedition, no C. of A., abandoned at Liefde Bay, Spitzbergen 9.24, s.o.r. 6.25



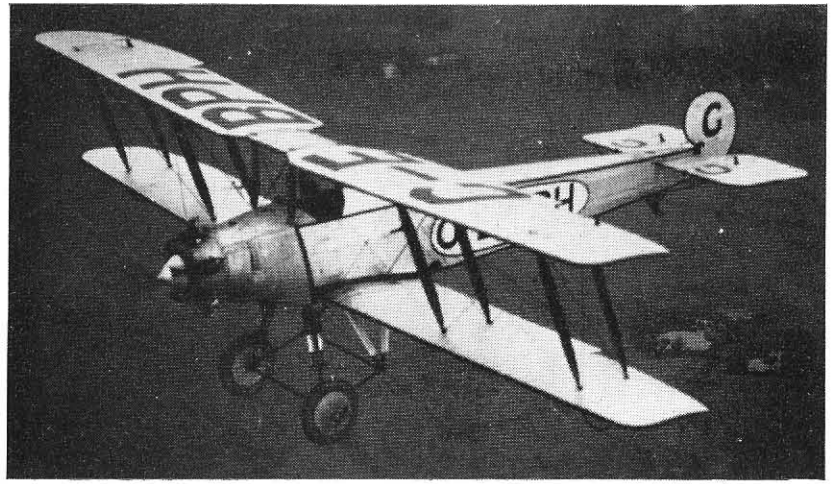
G-EBNE, prototype Avro 504R Gosport. (100 h.p. Gnome Monosoupape.)

Avro 504R Gosport

First flown in June 1926, the Avro 504R Gosport was the ultimate variation on the 504 theme and an attempt to produce a low powered version with a performance equal to that of the R.A.F. standard 130 h.p. Clerget 504K trainer. The 100 h.p. Gnome Monosoupape was chosen and a new lightweight engine mounting devised specially for it. Then by reworking and improving every part of the airframe to reduce the gross weight from 1,830 lb. to 1,690 lb., virtually a new aeroplane was created with all the characteristics of the Avro 504J. Tapered ailerons were fitted and all the old delightful handling characteristics were recaptured so that for a time the machine was referred to as the Avro 504J Mk. II. Cooling efficiency was improved by increasing the size of the front opening of the engine cowling, wing roots were cut back to improve the view as in the Avro 504N and a steerable tail skid fitted.

Two prototypes, *G-EBNE* and *'NF*, were built at Hamble the first of which became the firm's experimental 'hack' while the second was presented to the Lancashire Aero Club by Sir William Letts, Managing Director of A. V. Roe and Co. Ltd. at Woodford on April 16, 1926. Demonstrated by Avro test pilot H. J. Hinkler at the club's meeting two days later, it was used for instruction until Hinkler borrowed it on July 14 for a flight to Croydon for demonstration before the representatives of foreign governments. He also showed off the third Gosport *G-EBOX* (Manchester built) at a Yorkshire Aero Club meeting at Sherburn-in-Elmet during August with his usual artistry, resulting in the immediate sale of *'OX* abroad and in a number of overseas contracts.

Erratic engine behaviour kept *'NF* in its hangar at Woodford and so few flights were made that in the following November the Avro company replaced



Gosport *G-EBPH* as the Avro 585 with Avro Alpha engine and N-type undercarriage, leaving Woodford for the Helvellyn flight on December 22, 1926.

it with *G-EBQL*, second of their new Avian I light aeroplanes. Thereafter '*NF* flew only at long intervals eventually spinning in with two club members near Stockport in the autumn of 1928.

It was evident that without a modern power plant the Gosport would never achieve the standards of serviceability needed for military training schools. Plans to install a 100 h.p. Bristol Lucifer radial under the designation Avro 504S were eventually dropped in favour of a 90 h.p. Avro Alpha five cylinder radial specially designed for it. This engine was later built in small numbers by Crossley Ltd. who had a financial interest in A. V. Roe and Co. Ltd. but production ceased when Armstrong Siddeley took over. The first engine of this type was installed in the fourth Gosport *G-EBPH* built at Manchester in September 1926 which differed from earlier machines only in the shape of the nose and in the use of narrow chord hollow steel interplane struts.

Wishing to impress on the public that the aeroplane had become a useful and unique means of transport, the Director of Civil Aviation, Sir Sefton Brancker, persuaded Hinkler and the Lancashire Aero Club chairman J. F. Leeming to make a landing on the summit of Helvellyn (3,118 ft.). Before this exploit, successfully accomplished on December 22, 1926, a 504N-type undercarriage was fitted with which *G-EBPH* became the Avro 585. A solitary climber (Prof. Dodds of Birmingham University) signed a certificate showing that he had seen '*PH* land on the mountain. Taking off over Striding Edge, the machine then returned to Woodford and in 1928 was 'posted' to Hamble where its engine was eventually donated to an early autogiro.

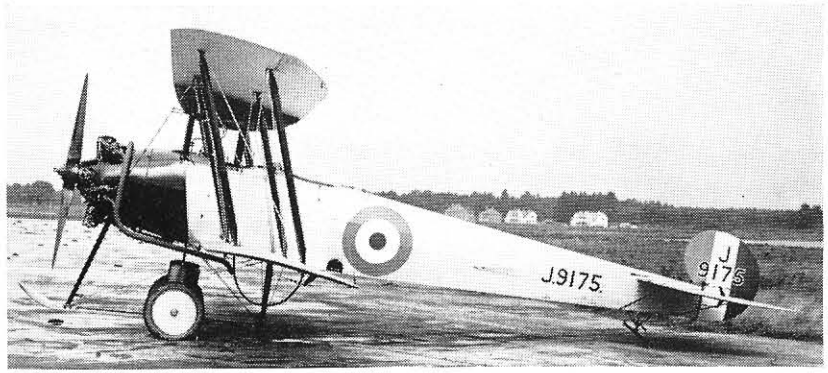
The first prototype Gosport *G-EBNE*, flown in the 1926 Bournemouth Easter Races by Hinkler and by Schneider Trophy pilot H. R. D. Waghorn

in 1927, was also used in the search for an alternative power plant, undergoing experimental fitment at Hamble with a 180 h.p. Armstrong Siddeley Lynx in July 1928. It later flew with Class B marking *K-6* and when Air Service Training Ltd. moved into Hamble in May 1931, '*NE* became an instructional airframe and was still there in 1935.

Final choice of engine fell midway between the Alpha and the Lynx so that the fifth Gosport *G-EBUY*, built at Manchester late in 1927, was powered by a 150 h.p. Armstrong Siddeley Mongoose. It retained the slim interplane struts but reverted to the skid undercarriage and carried fuel in two 12½ gallon 504N-type tanks under the upper mainplane. *G-EBUY* appeared at several meetings during 1928 but left the civil register in January 1929 and there is little reason to doubt that it was the Gosport evaluated by the



G-EBNE at Hamble in July 1928 with experimental 180 h.p. Armstrong Siddeley Lynx installation. (*P. T. Capon Photo.*)



The final, Armstrong Siddeley Mongoose powered, version of the Gosport. (*Crown Copyright Reserved.*)

R.A.F. at Martlesham in the same month as *J9175*. No Air Ministry contract was placed and the final civil machine *G-AACT* was eventually destroyed in an accident.

Production Mongoose Gosports, similar to *G-EBUY* but with the engine mounted uncowled as in the 504N, were supplied to the Estonian Air Force at Tallinn in November 1928 (still in use in 1940) and to the Peruvian Army Aviation Service. Ten were delivered to the Argentine Military Air Service in June 1927 and the Military Aviation Factory (Fábrica Militar de Aviones) opened at Cordoba, Argentina, on October 10, 1927 built 100 Avro 504R Gosport trainers under licence, the first of which made its first flight at the El Palomar School on October 2, 1928.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Fábrica Militar de Aviones, Cordoba, Argentina

Power Plants: One 90 h.p. Avro Alpha
One 100 h.p. Gnome Monosoupape
One 150 h.p. Armstrong Siddeley Mongoose
One 180 h.p. Armstrong Siddeley Lynx

Dimensions: Span 36 ft. 0 in. Length 28 ft. 11 in.
Height 10 ft. 8 in. Wing area 320 sq. ft.

Weights: (Gnome Mono)
Tare weight 1,107 lb. All-up weight 1,676 lb.
(Mongoose)
Tare weight 1,297 lb. All-up weight 1,907 lb.

Performance: (Gnome Mono)
Maximum speed 87 m.p.h. Cruising speed 70 m.p.h.
Initial climb 670 ft./min. Range 140 miles
(Mongoose)
Maximum speed 95 m.p.h. Cruising speed 75 m.p.h.
Initial climb 700 ft./min. Ceiling 12,000 ft.
Range 340 miles

Production:

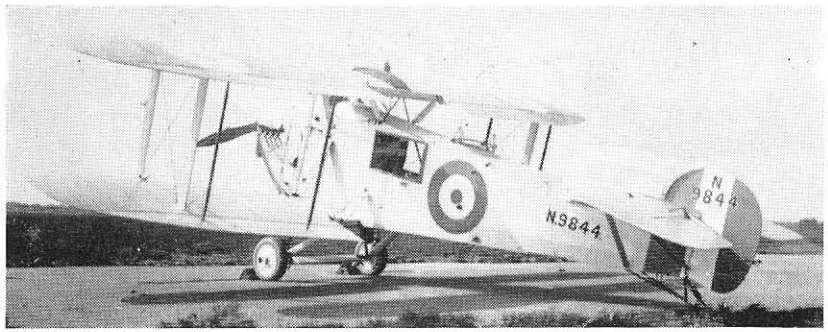
(*a*) **Prototypes**

Constructor's No. and Registration		*C. of A. Issued*	*Details*
5110	*G-EBNE*	15. 6.26	Gnome Mono: flown with Lynx 1928, later as *K-6*, instructional airframe Hamble 1931
5111	*G-EBNF*	6. 7.26	Gnome Mono: Light Planes (Lancs) Ltd.,* Woodford, crashed at Cheadle Hulme, Cheshire 21.10.28
R3/G/80086	*G-EBOX*	nil	Gnome Mono: sold abroad 8.26
R3/R/70000	*G-EBPH*	9.12.26	Alpha: converted to Avro 585, crashed 1.30
R3/CN/100	*G-EBUY*	26.11.27	Mongoose: to the R.A.F. 1.29 as *J9175* under Contract 787175/27
R3/CN/238	*G-AACT*	nil	Mongoose: crashed 1.30

*Trading as the Lancashire Aero Club.

(*b*) **Subsequent**

Argentina: Ten delivered 6.27, and 100 built under licence
Estonia: At least six, including *107*, *109*, *111* and *115* delivered 11.28
Peru: An unspecified number



A production Avro 555A Bison II with dorsal fin but without circular portholes forward. (*Crown Copyright Reserved.*)

Avro 555 Bison

The Bison was an exceedingly ugly deck-landing biplane for sea reconnaissance and fleet gunnery spotting to Specification 3/21 (D. of R. Type 7A). Although structurally similar to other wire braced biplanes designed by the company, its shape, purely functional and dictated by naval requirements, was little short of grotesque, largely because the pilot's cockpit was located high up in front of the top wing with the engine cowling sloping away steeply to give an unrestricted forward view when landing on an aircraft carrier. Power was provided by a 450 h.p. Napier Lion watercooled engine on a special mounting which also formed a work stand when the Lion was removed from the airframe for maintenance. High lift mainplanes were built round two spruce spars, rigged with 5 in. of back stagger, and arranged to fold for stowage aboard a carrier. Interplane struts were of tubular steel streamlined with fabric over wooden formers.

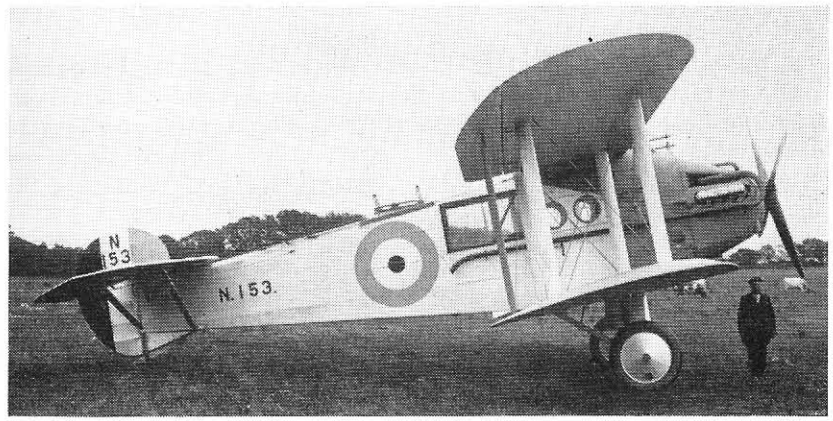
The fuselage was of tubular steel construction, the central part being plywood covered to form a cabin having large rectangular observation windows on each side. It allowed sufficient headroom for the crew to stand upright and housed all the radio and navigation equipment and even a plotting table. A rear gunner's position on a raised platform reached from the rear of the cabin was armed with a single Lewis gun on a Scarff mounting to supplement the pilot's fixed Vickers gun. Flotation bags were fitted in the rear fuselage and to provide buoyancy at the front end in the event of a forced landing at sea, fuel could be jettisoned from the 93 gallon main tank. The undercarriage was of standard Avro oil dashpot and rubber-in-compression design.

The first prototype Bison, *N153*, flown in 1921, had the upper mainplane mounted directly on top of the fuselage, three arrester wire claws (also tried on the Avro 504N *J7301*) fixed to the axle and had the tail supported by a simple

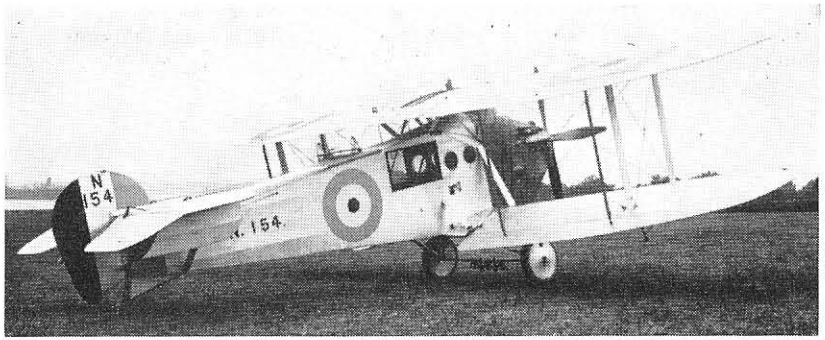
rubber sprung skid. *N154*, a second prototype to Specification 33/22, shown off by Hinkler before official guests at the Cub-engined Aldershot demonstration at Hamble on December 12, 1922 had the cutaway wing roots filled in and the top mainplane raised 15 inches above the fuselage on short struts. This permitted the insertion of a sliding communication hatch in the cabin roof behind the pilot. To improve directional control and stability the rudder was enlarged and auxiliary fins were mounted under the outer ends of the tailplane. Side bracing struts were also added to the bottom centre section, the long exhaust pipes of *N153* were abandoned and an improved metal tail skid fitted. A third prototype, *N155*, identical with *N153* but with a tail unit similar to *N154*, was shown in the New Types Park at the Hendon R.A.F. Display on June 30, 1923. It was taken on charge at the Wireless and Photographic Flight of the R.A.E., Farnborough, early in 1924 but was later based at Gosport.

Twelve Bison I aircraft similar to *N153* were then built and one was shown at the Prague Exhibition of May 31–June 9, 1924. Another, *N9594*, was later converted by the Hamble works into the Avro 555B Bison I amphibian with 22 ft. $4\frac{1}{2}$ in. mahogany boat-built central float, two small wing tip stabilising floats and retractable wheels. Performance trials on this aircraft were abandoned after preliminary handling flights at the M.A.E.E., Felixstowe, had shown longitudinal and directional instability, unsatisfactory behaviour on the water and inadequate elevator control below 70 knots.

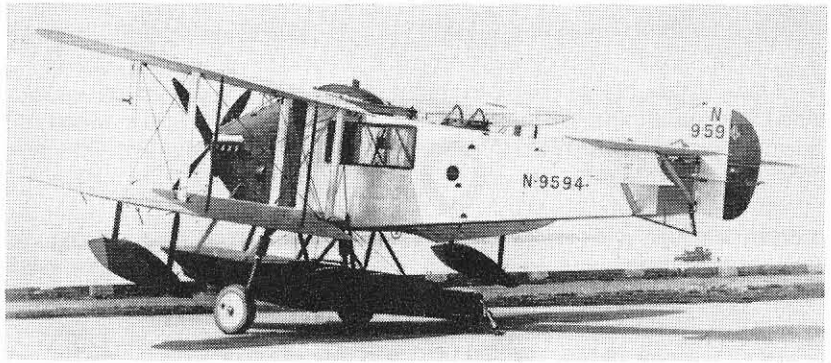
Main production batches to Air Ministry Specification 16/23, based on the second prototype with raised centre section, large dorsal fin replacing the small auxiliary units, and two bladed instead of four bladed airscrews, were designated Avro 555A Bison IA. Late production aircraft had the centre section gap further increased but were without the undercarriage arrester



N153, the first prototype Avro 555 Bison.



N154, second prototype Bison with centre section struts and increased mainplane gap.



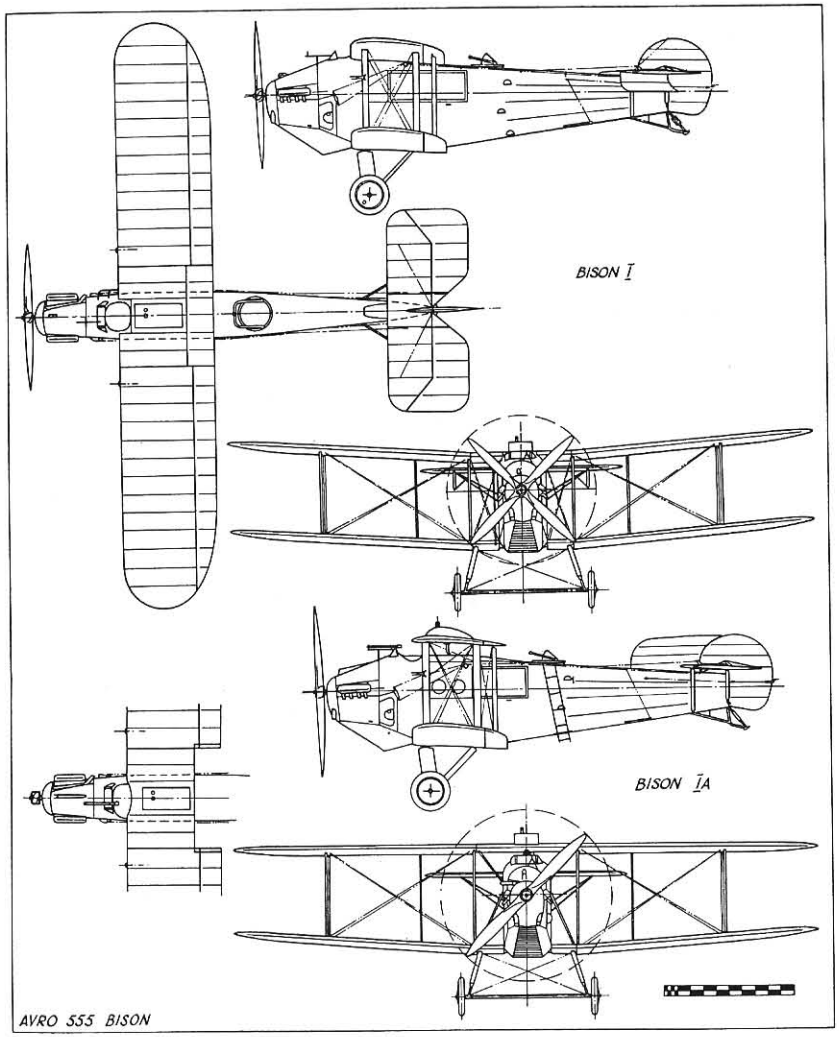
The Avro 555B Bison I amphibian. (*Crown Copyright Reserved.*)

claws and circular portholes forward. With these modifications the aircraft was known as the Bison II, but unlike the Bison I which had dihedral on both upper and lower mainplanes, the top wings of the Bison IA and II were without dihedral. First deliveries were made from Woodford to Gosport via Sealand and Farnborough (for acceptance tests) by H. J. Hinkler and A. G. B. Ellis in February 1925.

Although destined originally for deck landing, the Bison was first employed on Coastal Area reconnaissance duties, replacing Westland Walrus biplanes of No. 3 Squadron, R.A.F. at Gosport in 1922. The type was not issued to the Fleet Air Arm until No. 3 Squadron disbanded in April 1923, the first naval unit to receive the Bison II being No. 423 Fleet Spotter Flight, Gosport, which later took them to the Mediterranean in H.M.S. *Eagle*. Similar Flights, numbered 421, 421A, 421B, 447 and 448 served in the same carrier (some as target tugs), or with the Home Fleet in H.M.S. *Furious*, and No.

448 also served ashore at Hal Far, Malta. All were superseded by Fairey 111Fs in 1929.

Before final retirement the early Bison I *N9592* was transferred from Gosport to Farnborough where it served with the Engine Research Flight for a year on engine and radiator tests.



SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plant: One 480 h.p. Napier Lion II

Dimensions, Weights and Performances:

	Avro 555 Bison I	Avro 555A Bison II	Avro 555B amphibian**
Span	46 ft. 0 in.	46 ft. 0 in.	45 ft. 10 in.
Length	36 ft. 0 in.	36 ft. 0 in.	37 ft. 4½ in.
Height	13 ft. 6 in.*	14 ft. 2 in.	14 ft. 10½ in.
Wing area	620 sq. ft.*	630 sq. ft.	620 sq. ft.
Mainplane gap	6 ft. 9 in.*	8 ft. 3 in.	6 ft. 9 in.
Tare weight	4,160 lb.	4,116 lb.	4,972 lb.
All-up weight	5,800 lb.	6,132 lb.	6,244 lb.
Maximum speed	110 m.p.h.	108 m.p.h.	—
Cruising speed	90 m.p.h.	90 m.p.h.	—
Initial climb	600 ft./min.	450 ft./min.	—
Ceiling	14,000 ft.	12,000 ft.	—
Range	340 miles	360 miles	—

*Bison IA 13 ft. 10 in., 630 sq. ft. and 8 ft. 0 in. respectively.
**Felixstowe Report F/11 dated 20.8.25.

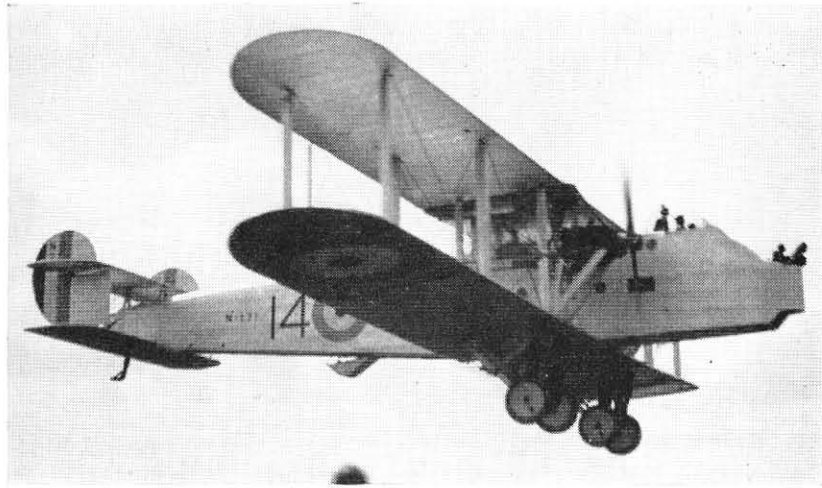
Production:

Prototypes: *N153*, *N154* (dismantled at Hamble 4.28), *N155*

Avro 555 Bison I. Twelve aircraft built at Manchester to Air Ministry order 1922: *N9591–N9602.* (*N9592* to the Engine Research Flight, R.A.E., 28.2.24; *N9594* rebuilt as the Avro 555B Bison I amphibian; others rebuilt as Bison IA.)

Avro 555A Bison II. Forty-one aircraft built at Manchester in four batches: *N9836–N9853* (18 aircraft) ordered July 1924; *N9966–N9977* (12 aircraft) December 1924; *S1109–S1114* (6 aircraft) November 1926; *S1163–S1167* (5 aircraft) February 1927. Delivery flights Sealand–Farnborough: *N9836* on 20.4.25, *N9838* (Hinkler) 28.2.25, *N9839* (Ellis) 28.2.25, *N9840* (Ellis) 5.3.25

Service Use: (*a*) R.A.F. 1922–23: No. 3 Squadron, Gosport. (*b*) Fleet Air Arm 1923–29: Fleet Spotter Flights Nos. 421, 421A, 447 with H.M.S. *Furious*, Home Fleet; Nos. 421B, 423, 448 with H.M.S. *Eagle*, Mediterranean Fleet.



The first prototype Avro 557 Ava *N171* (rounded wing tips) flying past at the Hendon R.A.F. Display on July 2, 1927. (*P. T. Capon Photo.*)

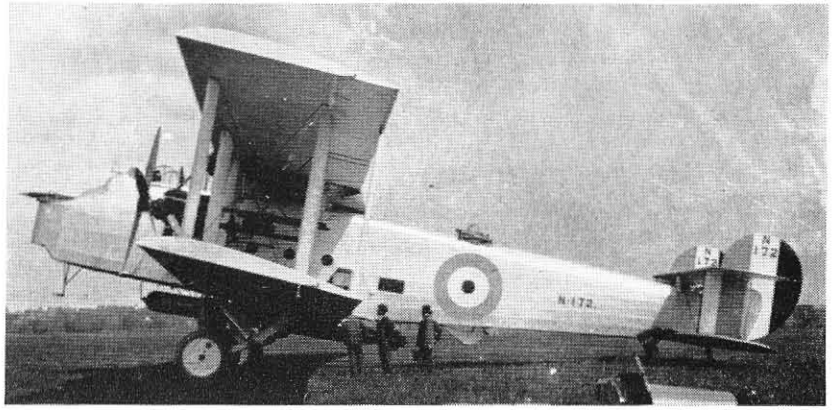
Avro 557 Ava

First conceived in November 1921 as the Avro 556 torpedo bomber to Specification 16/22 (D. of R. Type 9), the Avro 557 Ava was a large, three bay biplane designed by Roy Chadwick and intended originally for very long range coastal defence work or night bombing. The bombing role was eventually shelved and the first Ava prototype, *N171*, was completed purely for coastal work. Gun positions were built into the nose and the rear fuselage aft of the wings, the space under the tail was covered by a third gunner in a retractable 'dustbin', and the machine could carry 2,000 lb. of bombs internally or a single 21 in. Whitehead torpedo between the twin undercarriage units.

Powered by two uncowled 650 h.p. Rolls-Royce Condor III watercooled engines gravity fed from fuel tanks immediately above them, the Ava was of wooden construction with folding wings and dual control for two pilots side by side in an open cockpit. The rudders were possibly the largest of the famous Avro comma type ever built and formed part of an enormous biplane tail.

Although built at Hamble in 1924 the machine did not appear in public until numbered 14 in the New Types Park at the Hendon R.A.F. Display on July 3, 1926. A second Ava prototype, *N172*, shown at the Hendon Display on July 2, 1927 was largely similar to the first, but was of metal construction throughout and identified by square-cut instead of rounded wing tips.

The adoption of the 18 inch British Admiralty Mk. VIII as the standard naval torpedo made the size of the aircraft unnecessary and there was no production.



The second Ava *N172* with torpedo in position and showing the square cut wing tips. (*P. T. Capon Photo.*)

It is a point of interest that another set of drawings, still in existence and also numbered Avro 557, depict a single seat monoplane. This project, dated January 5, 1923 or nearly nine months before the Ava, envisaged an Avro 552 fuselage (complete with Wolseley Viper engine), mounted on an Avro 504N undercarriage and attached to a parasol wing wire braced to a central kingpost. Although the scheme was dropped and the type number reallotted, performance calculations gave an estimated tare weight of 1,600 lb., all-up weight 2,450 lb., maximum speed 110 m.p.h., initial climb 1,000 ft./min. and ceiling 20,000 ft.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

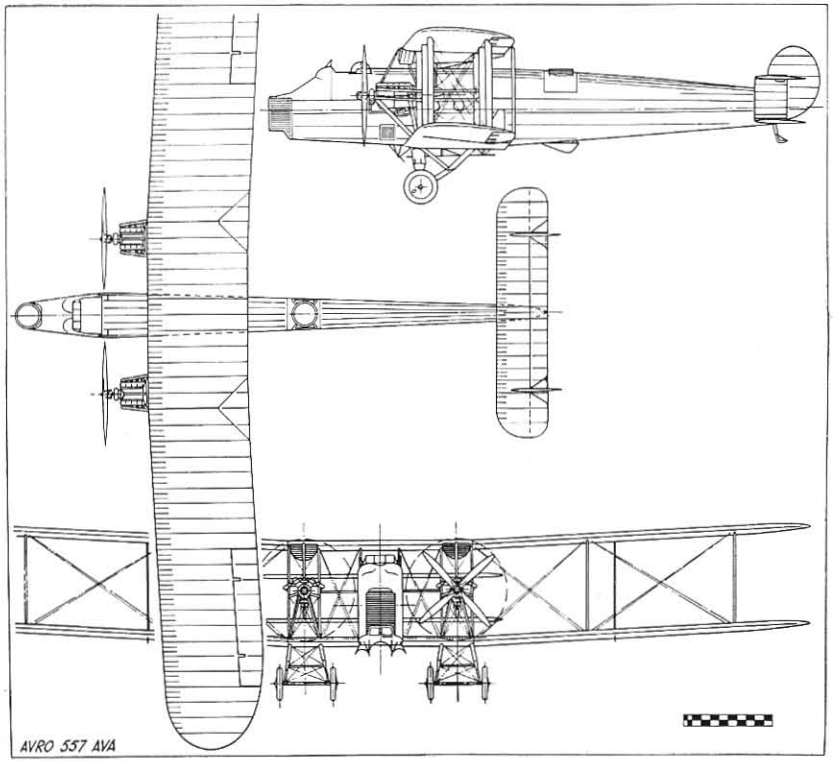
Power Plants:
(Avro 556 project) One 1,000 h.p. Napier Cub
(Ava) Two 650 h.p. Rolls-Royce Condor III

Dimensions:
(Avro 556 project) Span 95 ft. 0 in. Length 58 ft. 3 in.
(Ava *N171*) Span 96 ft. 10 in. Length 61 ft. 9 in.
Height 19 ft. 7¾ in.
Wing area 2,163 sq. ft.
(Ava *N172*) Span 95 ft. 4 in.

Weights:
(Ava *N171*) Tare weight 12,760 lb.* All-up weight 19,920 lb.
(Ava *N172*) Tare weight 13,304 lb. All-up weight 20,465 lb.

*13,020 lb. at Martlesham trials.

Production: Two prototypes only, *N171* and *N172*, of wood and metal construction respectively. *N172* was completed and weighed at Hamble 21.4.27 and first flown next day.





The Avro 558 ultra light biplane No. 5 with B. and H. Vee twin engine at Lympne, October 1923. (*'Flight' Photo.*)

Avro 558

The unnamed Avro 558 was a small biplane, two examples of which were built at Hamble for the *Daily Mail* performance trials for light single seaters held at Lympne October 8–13, 1923. Chief designer Roy Chadwick chose the biplane configuration on account of its small overall dimensions, low structural weight, narrow chord mainplanes and small c.p. travel. A. V. Roe thought otherwise and designed a clean cantilever monoplane under designation Avro 560.

The Avro 558s had heavily staggered, R.A.F.15 section, high aspect ratio mainplanes braced by circular section wire. They were supported on solid spruce I-type interplane and centre section struts of streamline section into the slotted ends of which were riveted Vee shaped duralumin plates bolted to fittings on the spars. The pilot sat on the floor of a conventional wire braced, fabric covered wooden fuselage with his head projecting through a hole in the hinged plywood decking. To keep down head resistance still further the undercarriage, comprising two 22 in. diameter bicycle wheels mounted on a steel tube axle sprung by rubber cord, was located inside the fuselage with only the lower half of the wheels protruding. Their track was so narrow and the bottom wing so near the ground that strong wing tip skids were needed.

Entered by A. V. Roe and Co. Ltd. and flown by H. J. Hinkler, the first (unregistered) Avro 558 No. 5 was powered by a B. and H. direct drive, twin cylinder, aircooled Vee-type motorcycle engine. The second, *G-EBHW* No. 11, built for G. S. Bush and H. A. Hamersley (who flew the machine), was also equipped with a motorcycle engine, a 500 c.c. twin cylinder, horizontally opposed Douglas, complete with external flywheel and driving the

airscrew through a $2\frac{1}{2}$: 1 chain reduction gear. This was by far the better performer of the two and on the opening day of the trials Hamersley completed four laps of the $12\frac{1}{2}$ mile Lympne circuit and reached a height of 6,750 ft. He then exploited its high flying potential and although he failed to beat the A.N.E.C. I in this respect, 13,850 ft. reached on October 13 was no mean achievement in turbulent conditions. For this he received the Duke of Sutherland's £100 prize.

A temperamental engine prevented Hinkler from making any laps of the circuit in No. 5 and when Lt. Barrett flew it on October 13, he was forced to land by the high winds and the machine was damaged. After the competition No. 5 was taken back to Hamble where the nose of the fuselage was modified



The second Avro 558 *G-EBHW* with 500 c.c. Douglas flat twin engine.



The second Avro 558 No. 11/*G-EBHW* at Hendon on October 27, 1923 with raised undercarriage and wing tip skids. (*H. H. Grant Photo.*)



No. 5, the first Avro 558, in modified form with 698 c.c. Blackburne Tomtit engine and Vee-type undercarriage. (*Avro Photo.*)

to take a 698 c.c. Blackburne Tomtit engine. The close proximity of the lower wing to the ground undoubtedly made landing difficult in long grass or on rough surfaces and both machines were modified accordingly. No. 5 was fitted with a light weight strutted undercarriage with aircraft wheels, while No. 11 was raised on its existing bicycle wheels by means of two wide vertical struts, probably those removed from the Avro 560 monoplane. It was raced in this form at the Royal Aero Club Light Plane Demonstration at Hendon on October 27, 1923 by H. A. Hamersley, who flew a low and stylish race in high wind and came third.

SPECIFICATION AND DATA

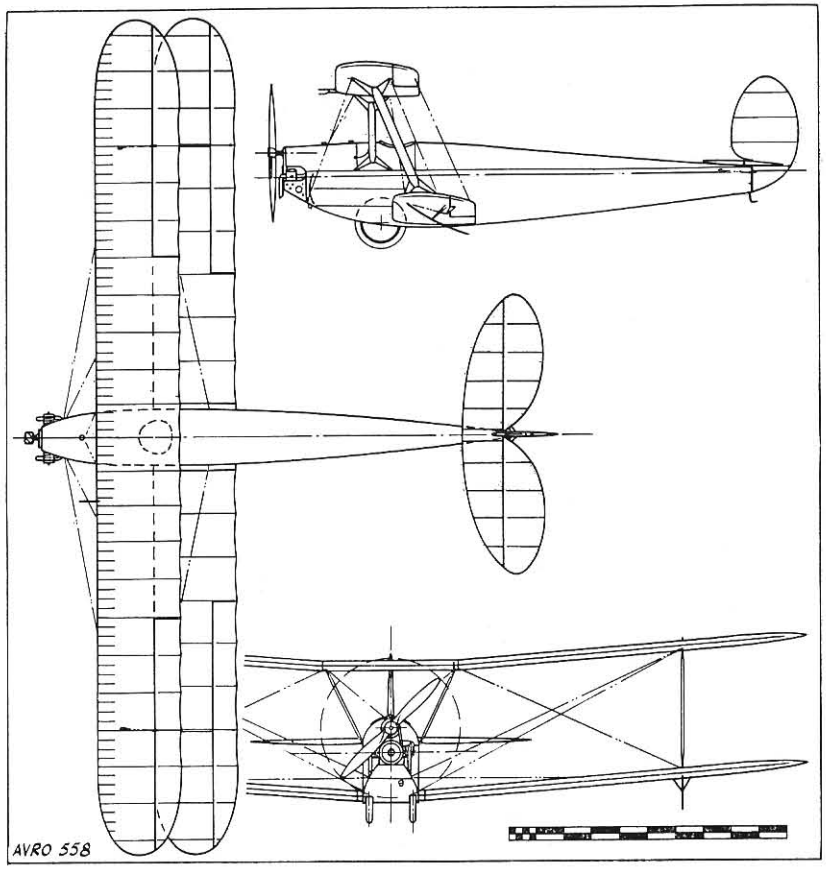
Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: One B. and H.
One 500 c.c. Douglas
One 698 c.c. Blackburne Tomtit

Dimensions: Span 30 ft. 0 in. Length 19 ft. 6 in.
Wing area 166 sq. ft.

Weights: Tare weight 294 lb. All-up weight 480 lb.

Production: Two aircraft only, 1923 Lympne trials No. 5; and No. 11, c/n 5089, registered to G. E. Bush and H. A. Hamersley 19.9.23 as *G-EBHW*, a registration which eventually lapsed





The Avro 560 ultra light monoplane with upright Tomtit engine as flown at Lympne, October 1923.
(Photo courtesy of the Royal Aeronautical Society.)

Avro 560

In addition to the Avro 558 biplanes, the Hamble works also produced an ultra light, high aspect ratio cantilever monoplane which was flown in the 1923 Lympne trials by H. J. Hinkler. Known as the Avro 560 and said to have been designed personally by A. V. Roe, it received competition No. 6 and distinguished itself during the meeting by completing 80 laps of the 12½ mile circuit (1,000 miles) without a forced landing. Its fuel consumption worked out at 63.3 m.p.g. and at one stage of the trials the machine completed 10 laps (125 miles) non-stop.

The fuselage was of typical Avro fabric covered, wooden construction with a tapered, biconvex section, cantilever mainplane bolted directly to the top longerons with the pilot's cockpit between the spars. A 698 c.c. Blackburne Tomtit upright Vee twin aircooled engine was bolted to a duralumin plate on the front end of the fuselage and the undercarriage, unlike those of the biplanes, consisted of two short struts projecting below the fuselage and carrying two light wooden wheels on a rubber sprung steel axle. The tailplane was a cantilever unit built in two halves which bolted together through the fuselage as on the 558 and the altimeter was inside the wing root so that there were no pipelines to disconnect when the wing was removed.

Provision was made for the substitution of an alternative mainplane of reduced span under the designation Avro 559 to give higher speeds for competition purposes when required. Unfortunately the Lympne officials ruled that with the short span wing it would rank as a different aeroplane. They would not therefore allow the change because the machine had not been separately entered in that condition.

Hinkler flew the Avro 560 again at the R.Ae.C. Light Plane Demonstration at Hendon on October 27, 1923 but was forced down with engine trouble. Wear on the inlet valve stems had been a continuous problem with this engine, and when the aircraft was taken on Air Ministry experimental charge as *J7322* for assessment at Martlesham against the Parnall Pixie II and the D.H.53 Humming Bird in 1924, one of the new Blackburne Tomtit inverted engines was fitted. It was also given an orthodox strutted undercarriage

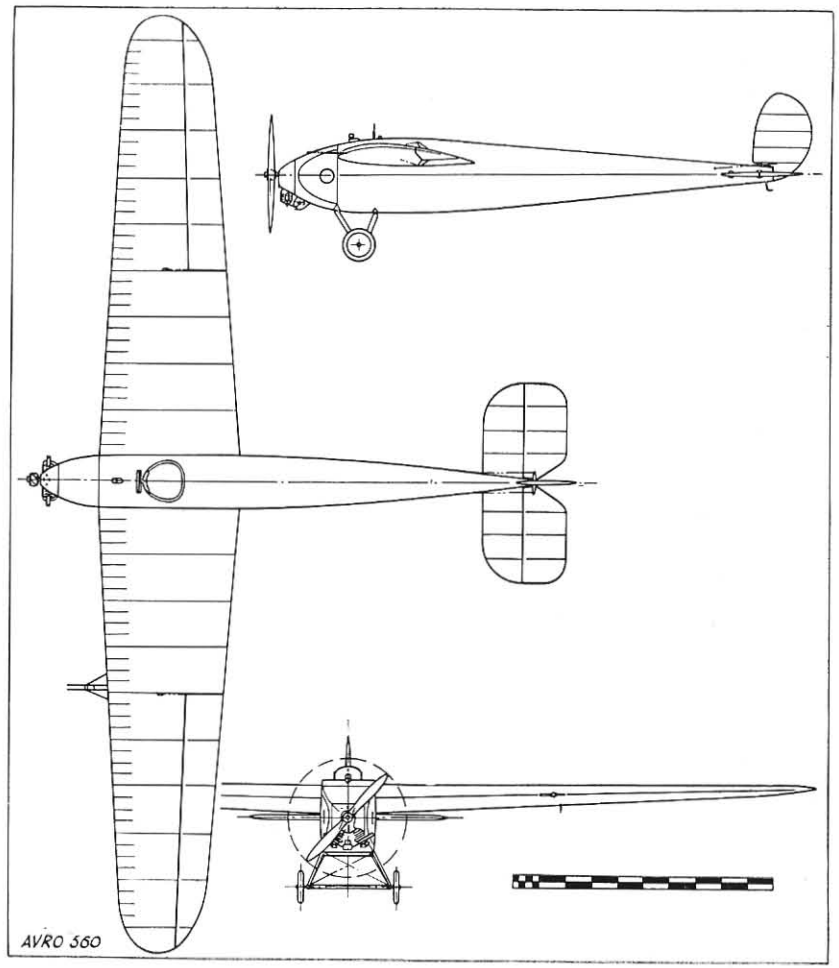
with aircraft wheels of the type fitted to Avro 558 No. 5, and the rear circular portholes filled in. At a time of stringent economy the R.A.F. needed a cheaply run aircraft of this kind for practice flying and communication but choice fell on the D.H.53 and no further Avro 560 monoplanes were built.



The Avro 560 at Martlesham in 1924 with Vee-type undercarriage, inverted Tomtit engine and serial *J7322*.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Power Plants:	One 698 c.c. Blackburne Tomtit upright engine One 698 c.c. Blackburne Tomtit inverted engine
Dimensions:	Span 36 ft. 0 in. Length 21 ft. 0 in. Wing area 138 sq. ft.
Weights:	Tare weight 285 lb. All-up weight 471 lb.
Production:	One aircraft only, 1923 Lympne trials No. 6, remodelled in 1924 and transferred to the R.A.F. as *J7322* under Contract 487256/24





The first Avro 561 Andover *J7261* taxying out at the Hendon R.A.F. Display on June 28 ;1924.

Avro 561 Andover

Built to R.A.F. order to replace D.H.10s on the Cairo–Baghdad desert air route, the Andover could be equipped alternatively as passenger transport or ambulance. It used the same folding mainplanes, undercarriage and tail unit as the Avro 549 Aldershot but the fuselage was entirely new. This was built in three sections and comprised a steel tube cantilever engine mounting and shutter-equipped radiator compartment, an oval section wooden monocoque cabin amidships and a fabric covered tubular steel after-section to fair it neatly into the tail.

The cabin portion, 22 ft. long, 4 ft. 9 in. wide and with 6 ft. headroom, accommodated up to 12 passengers in wicker chairs (six each side of a central gangway) or six stretcher cases, and was built up from large oval rings and stringers covered inside and out with plywood. The air space between provided insulation against temperature variations and noise. Large openable windows ran the length of each side and entry was via a rectangular trapdoor in the starboard side.

The pilot sat in an open cockpit just below the leading edge of the centre section with the navigator alongside and at a slightly lower level with direct access to the cabin through a door in its forward bulkhead. Fuel was carried in two large aerofoil section slipper-type gravity tanks on top of the wing, while long multiple R.A.E. perforated exhaust pipes acted as silencers.

When the desert air route was transferred to Imperial Airways Ltd., the order was cut back and only three Andovers were built initially, the first of which, *J7261*, was shown in the New Types Park and flown past at the Hendon R.A.F. Display on June 28, 1924. All three then went into service at R.A.F. Halton. Early in 1925 a fourth machine, the purely civil Avro 563 12 passenger version (also named Andover) was built to Air Ministry order. It was the first Avro machine to be built specially for airline service on main routes and was largely similar to the military transport with six single seats down each side of a central gangway, but with lavatory and luggage

accommodation in the rear. The Avro 563 was registered *G-EBKW* and after airworthiness test flights at Hamble and Gosport in March 1925, was loaned to Imperial Airways Ltd., Croydon, for cross-Channel proving flights during the summer of that year.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 561) One 650 h.p. Rolls-Royce Condor III
(Avro 563) One 650 h.p. Rolls-Royce Condor III

Dimensions: (Avro 561) Span 68 ft. 0 in. Span (folded) 27 ft. 6 in.
Length 51 ft. 3 in. Height 15 ft. 3 in.
Wing area 1,062 sq. ft.

(Avro 563) Span 68 ft. 0 in. Span (folded) 27 ft. 6 in.
Length 51 ft. 7 in. Height 16 ft. 1½ in.
Wing area 1,064 sq. ft.

Weights: (Avro 561) Tare weight 6,980 lb.* All-up weight 11,500 lb.*
(Avro 563) Tare weight 6,800 lb. All-up weight 10,685 lb.

*6,987 lb. and 11,793 lb. at Martlesham trials.

Performances: (Avro 561) Maximum speed 110 m.p.h. Ceiling 13,500 ft.
Range 460 miles

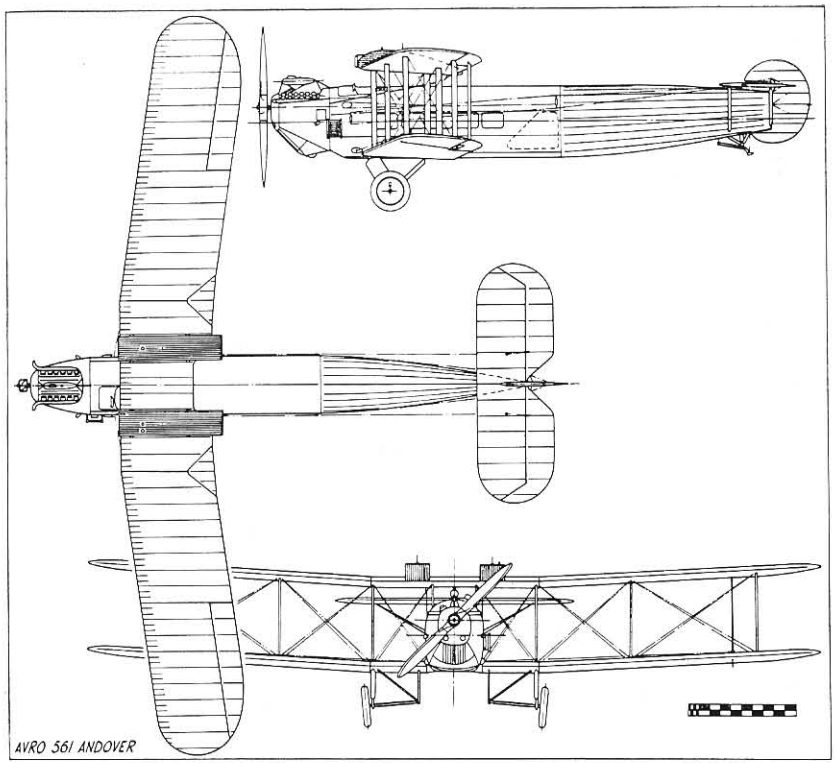
(Avro 563) Maximum speed 110 m.p.h. Cruising speed 90 m.p.h.
Initial climb 400 ft./min. Ceiling 10,000 ft.

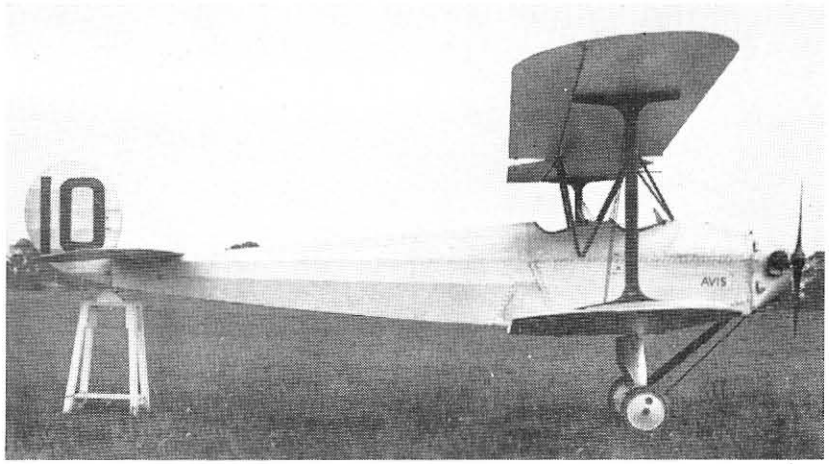
Production: (*a*) For the R.A.F.—three aircraft only *J7261* to *J7263* to Contract 458918/23.

(*b*) Civil—one aircraft only, *G-EBKW* c/n 5097, registered to the Air Council 27.2.25, C. of A. issued 21.4.25, loaned to Imperial Airways Ltd. 1925, handed over to the R.A.F. 1.27, almost certainly as *J7264*



The Avro 563 Andover civil transport. (*P. T. Capon Photo.*)





The Avro 562 Avis in early form with 32 h.p. geared Bristol Cherub II driving a wooden airscrew.

Avro 562 Avis

The Avis, Avro entry for the Air Ministry's Two Seat Light Aeroplane Trials held at Lympne September 29–October 4, 1924 was a small equal span, single bay biplane slightly reminiscent of the Avro 514 of 1914 with circular rudder and single I-type interplane struts. The fuselage was the usual wire braced, fabric covered Warren girder with plywood top decking, and the wings were designed to fold to comply with the rules of the competition. A pair of steel Vee shaped jury struts were provided to support the inner ends when folded. Ailerons ran the full length of all four wings, the upper pair being linked to the lower by rods at the inner end so that all four could be depressed to act as flaps on final approach by means of an ingenious worm drive mechanism. A long travel oleo undercarriage with front radius rods completed a very business-like little aeroplane.

Although first flown at Hamble with a 35 h.p. Blackburne Thrush direct drive, three cylinder radial, an alternative mounting was built to enable a 32 h.p. Bristol Cherub II geared horizontally opposed engine to be substituted when required. Remembering the previous year's disappointment when competition regulations prevented the Avro 560 monoplane from flying at Lympne with the short span mainplane, the Avis biplane was entered as two separate aeroplanes, No. 10 with Cherub and No. 11 with Thrush. In the event this precaution was unnecessary as the Thrush was not used.

When the machine was delivered at Lympne by road on September 28, the Cherub had not yet been installed but this work was completed during the next two days. Unfortunately snags were encountered and the engine appeared to give only half power. After several attempts during the afternoon of

September 30, Hinkler managed to get the Avis airborne, but not daring to venture round the course, was eliminated from the competitions. This was most regrettable because on October 2 the Cherub performed to such effect that the Avis reached a height of 2,000 ft. Nevertheless a new direct drive Cherub I of proven reliability was substituted and on October 1 Hinkler gave flights to Director of Civil Aviation Sir Sefton Brancker and Air Vice-Marshal Sir Geoffrey Salmond. Next day Avro enterprise was at last rewarded when, in a field of 13 aircraft, Hinkler won the Grosvenor Challenge Trophy and £100 by flying the Avis eight times round the 12½ mile course at an average speed of 65·87 m.p.h.



The Avis in 1925 with direct drive Cherub and duralumin airscrew.



The Avis at the 1926 Lympne Trials with 1,500 c.c. Blackburne Thrush three cylinder radial.

With his wife as passenger, Hinkler then flew the Avis triumphantly back to Hamble with a night stop at Croydon on October 6 and a fuelling stop at Farnborough next day.

The Avis reappeared at the Lympne August Meeting on August 1, 1925 still with direct drive Cherub, which this time drove a duralumin airscrew specially made for it by Avro. Hinkler, very familiar with the 12½ mile circuit, came third in the International Light Aeroplane Holiday Handicap at 64·8 m.p.h. and fifth in the Grosvenor Challenge Trophy Race at 65·32 m.p.h. At this stage the Avis cowlings differed from those of the previous year because the cylinder heads of the direct drive Cherub were lower in relation to the thrust line of the airscrew than those of the geared engine. It also bore civil registration *G-EBKP* allocated to it in December 1924.

As 'second string' to Avro's new Avian prototype for the Two Seat Light Aeroplane Trials at Lympne, September 12–17, 1926, the Avis reverted to a Thrush engine, this time the new and slightly heavier 1,500 c.c. (38 h.p.) model. Painted yellow and flown by Wing Cdr. W. Sholto Douglas (later Lord Douglas of Kirtleside), the machine averaged 51·25 m.p.h. to Shoreham and back on the first day but was eliminated when the undercarriage was damaged in a forced landing on the second.

In the following year Avros refitted the direct drive Cherub I and disposed of the Avis to private owner E. L. O. Baddeley who kept it only a few months before advertising it for sale for £250. The price dropped to £100 in the following August and the machine was eventually acquired by T. S. Baldwin, garage proprietor of Totnes, Devon, who finally scrapped it at the end of 1931.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

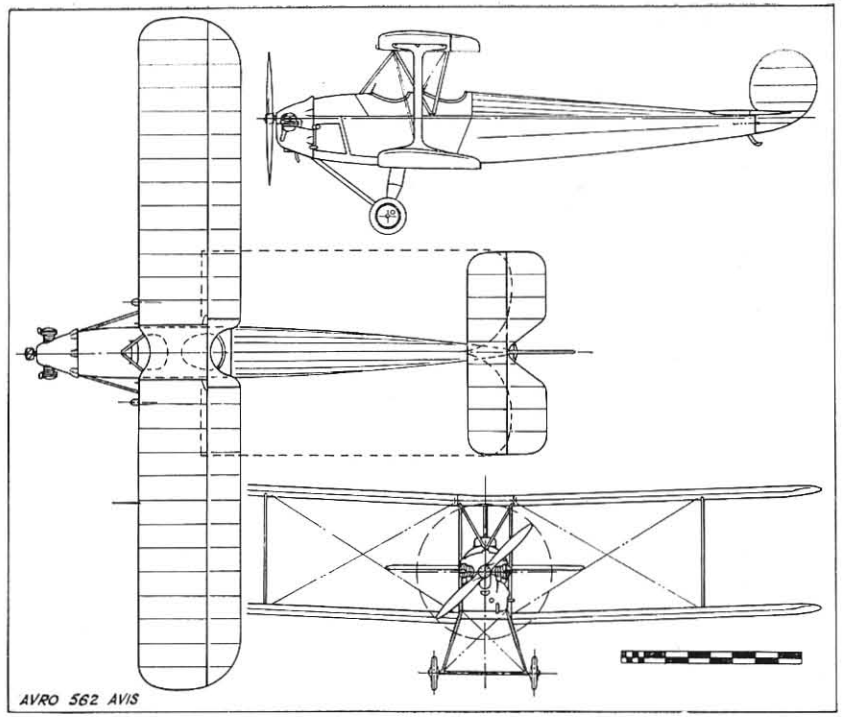
Power Plants: One 1,096 c.c. (35 h.p.) Blackburne Thrush
One 1,700 c.c. (38 h.p.) Blackburne Thrush
One 1,096 c.c. (32·6 h.p.) Bristol Cherub I direct drive
One 1,096 c.c. (32·6 h.p.) Bristol Cherub II geared

Dimensions: Span 30 ft. 1 in. Span (folded) 9 ft. 0 in.
Length 24 ft. 0 in. Height 9 ft. 0 in.
Wing area 246 sq. ft.

Weights: (1,096 c.c. Thrush)
Tare weight 590 lb. All-up weight 995 lb.
(1,700 c.c. Thrush)
Tare weight 606 lb. All-up weight 1,050 lb.
(Cherub I) Tare weight 565 lb. All-up weight 943 lb.
(Cherub II) Tare weight 575 lb. All-up weight 960 lb.

Performance: Maximum speed 75 m.p.h.

Production: One aircraft only, *G-EBKP* c/n 5105, registered to A. V. Roe and Co. Ltd. 19.12.24; C. of A. issued 1.2.26; sold 10.27 to E. L. O. Baddeley; to T. S. Baldwin, Baldwin's Garage, Totnes, Devon 10.28; scrapped 12.31





The Avenger in its first, Avro 566, form.

Avro 566 Avenger

The Avenger was a private venture single seat fighter designed by Roy Chadwick and first flown at Hamble by H. J. Hinkler on June 26, 1926. It was a single bay biplane powered by a 525 h.p. direct drive Napier Lion VIII turning a two bladed wooden airscrew, and cooled by Lamblin radiators built into the underside of the upper mainplane. The mainplanes were built up from two spruce spars with plywood ribs, fabric covered, rigged with N-type interplane struts and fitted with ailerons on the top wing only.

One of the cleanest biplanes built up to that time, the Avenger was unique in its day by virtue of its oval section semi-monocoque fuselage of elm frames and spruce longitudinals, double planked with mahogany, fabric covered and varnished. Tailplane and fin were cantilever units bolted to stub spars built integral with the fuselage. The pilot's seat was beneath a cut-out in the trailing edge of the centre section and the undercarriage was of normal cross-axle type with oleo and rubber-in-compression front legs and rubber sprung tail skid. Fuel from a 56 gallon fuselage tank was fed to the engine via a small gravity tank in the centre section.

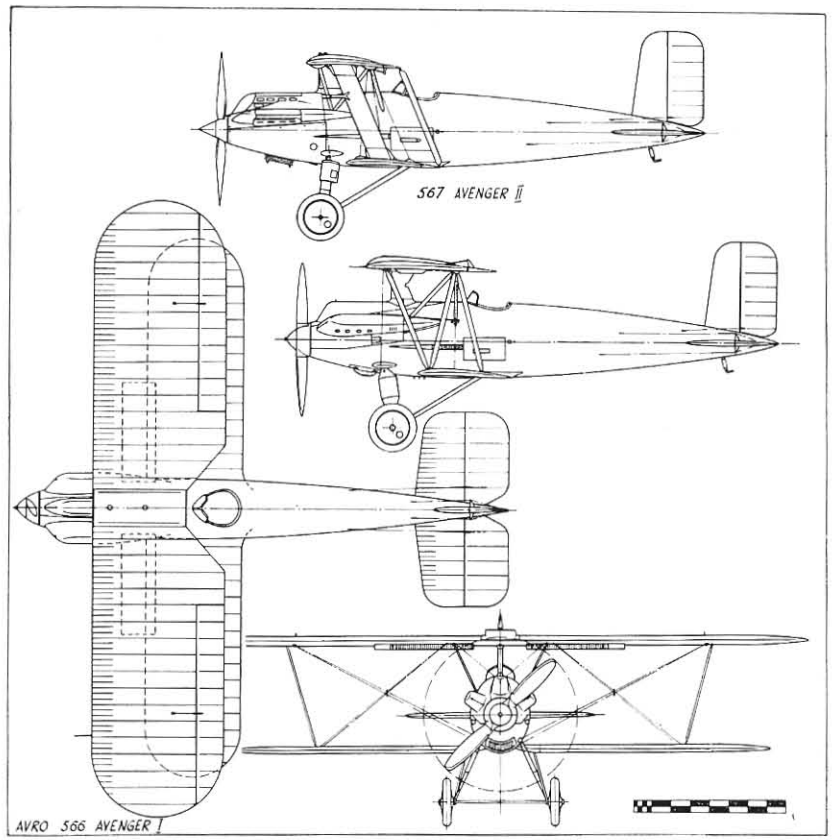
In company with the Gloster Gorcock and Hawker Hornbill fighter prototypes, the Avenger disported in civil markings *G-EBND* at the Hendon R.A.F. Display on July 3, 1926. None of the three was adopted for the Royal Air Force and in the following year '*ND* was entered for the King's Cup Race by Sir Kenneth Crossley, chairman of Crossley Motors Ltd. which had a considerable financial interest in A. V. Roe and Co. Ltd. When the impossibly high handicap speed of 244 m.p.h. was announced, Crossley's pilot F/Lt. S. L. G. 'Poppy' Pope reluctantly scratched the Avenger from the race.

The original design aimed at wide overseas appeal by providing for wings with differing characteristics to suit a number of diverse roles. Advantage was

taken of this feature in May 1928 when the Avenger returned to Hamble to be fitted with smaller, equal span mainplanes, and streamlined, I-type interplane struts for racing purposes. To improve the rate of roll when cornering, ailerons were fitted to all four wings, the main undercarriage legs were raked slightly forward and a new 553 h.p. Napier Lion IX engine driving an Avro metal airscrew was installed under improved cowlings.

In this form, as the Avro 567 Avenger II, it was aerobatted by F/Lt. F. L. Luxmoore D.F.C. at the Hampshire Air Pageant, Hamble, on May 27–28 and Blackpool Meeting at Squires Gate on July 6, 1928. Next day Schneider Trophy pilot F/Lt. S. N. Webster averaged 180·25 m.p.h. in the Open Handicap Race and came second to an Avro Avian, his speed on the straight being such that A. V. Roe entered the machine for the King's Cup Race at Hendon on July 20, 1928. Flown by F/O J. 'Mutt' Summers, it won £100 for fastest time in the race and touched down at Brooklands next day in 13th place, having averaged 149 m.p.h. over the 1,096 miles to Renfrew and back.

Proposals were also made in 1927 to fit the Avenger with wings of R.A.F.30



section as the Avro 569; with a 570 h.p. geared Napier Lion XI as the Avro 583; and to incorporate other extensive modifications under type number Avro 602, but all these schemes came to nought. Still in Avro 567 configuration the Avenger left for Bucharest on September 6, 1928 in company with the Vickers Vivid *G-EBPY* for demonstration before the Rumanian authorities. No orders were received and the Avenger returned to Hamble, where it remained until Air Service Training Ltd. took over in May 1931 and dismantled it for use as an instructional airframe.



The modified Avro 567 Avenger II taking off from Hendon in the King's Cup Race on July 20, 1928. (*'The Aeroplane' Photo.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 566) One 525 h.p. Napier Lion VIII
(Avro 567) One 553 h.p. Napier Lion IX

Dimensions: (Avro 566) Span (upper) 32ft. 0in. (lower) 28 ft. 0in.
Length 25ft. 6in. Height 10 ft. 3 in.
(Avro 567) Span 28 ft. 0 in. Length 25 ft. 6 in.
Height 9 ft. 9 in. Wing area 244 sq. ft.

Weights: (Avro 566) Tare weight 2,368 lb. All-up weight 3,220 lb.
(Avro 567) All-up weight 3,414 lb.

Performances: (Avro 566) Maximum speed 180 m.p.h.
Cruising speed 130 m.p.h.
Initial climb 2,100 ft./min. Ceiling 22,000 ft.

Production: One aircraft only, Avro 566 *G-EBND* c/n 5109, C. of A. issued 11.7.26, to Martlesham 10.26, converted to Avro 567 in 1928, to instructional airframe 1931



The Avro 571 Buffalo I *G-EBNW*, showing the rounded wing tips and ailerons on the lower mainplane only.

Avro 571 Buffalo

This was a two seat, private venture deck landing, torpedo carrying and bombing landplane to Specification 21/23, powered by a 450 h.p. Napier Lion VA and first flown at Hamble in 1926. Intended as a Bison replacement, the Buffalo was a single bay folding biplane which used much of the wing structure of the Bison II. Wing spars were of spruce, with spruce and duralumin ribs, tubular steel drag struts and steel tie rod internal bracing. Ailerons were fitted to the lower mainplane only and the tailplane was adjustable for incidence. The fin and rudder were those of the Bison II and the wide track divided undercarriage was sprung by long travel oleo and rubber-in-compression shock absorbers.

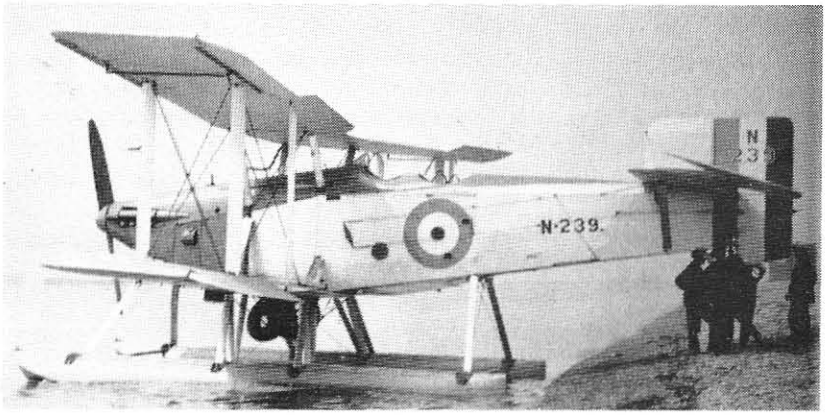
The fuselage, of entirely new design, was of tubular steel construction with duralumin decking and fabric sides, in which the pilot sat high up under a cut-out in the centre section with an excellent forward view for landing on an aircraft carrier. The second crew member sat behind, with access to both the radio cabin and a prone bombing (or camera) position in the bottom of the fuselage. Armament consisted of one Vickers gun on the side of the fuselage firing through the airscrew, and twin Lewis guns on a Scarff mounting on the rear cockpit. Flotation bags were located in the rear fuselage and a dump valve

was fitted to the 160 gallon main fuel tank so that it could provide extra buoyancy in the event of a forced landing at sea.

Early in the Buffalo's career, the Bison fin and rudder was replaced by a large rectangular unit. To improve performance and handling qualities and thus increase its chances of adoption in the face of competition from the Blackburn Ripon and Handley Page H.P. 31 Harrow machines built to the same specification, the Buffalo was flown back to Hamble from Martlesham in 1927 to be fitted with an entirely new set of mainplanes. The new wings were entirely of metal, more rectangular, and fitted with four Frise ailerons



G-EBNW rebuilt as the Avro 572 Buffalo II with rectangular wings and four Frise-type ailerons.



The Buffalo II as a seaplane in military marks, Hamble 1928. (*P. T. Capon Photo.*)

and controllable Handley Page slots. Thus equipped and re-engined with a 530 h.p. Napier Lion XIA, it was known as the Avro 572 Buffalo II.

In July 1928 the Buffalo II was acquired by the Air Ministry and converted at Hamble into a seaplane with single step, Vee bottomed duralumin floats and flown to Felixstowe. A purely bomber version in landplane form, considered under type number Avro 597, was not proceeded with.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: (Avro 571 Buffalo I) One 450 h.p. Napier Lion VA
(Avro 572 Buffalo II) One 530 h.p. Napier Lion XIA

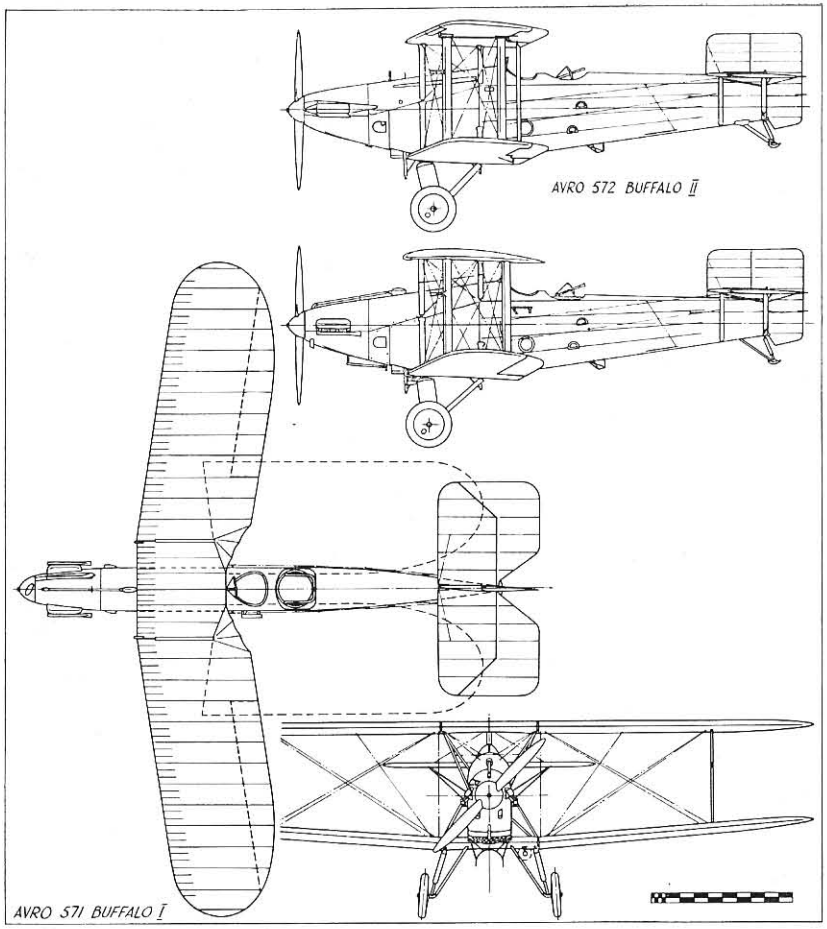
Dimensions: (Avro 571) Span 46ft. 0in. Length 36ft. 6in.
Height 13 ft. 9 in.
(Avro 572) Span 46 ft. 0 in.
Length 37 ft. 3 in. (seaplane) 38 ft. 6 in.
Height 14 ft. 0 in. (seaplane) 14 ft. 2 in.
Wing Area 684 sq. ft.

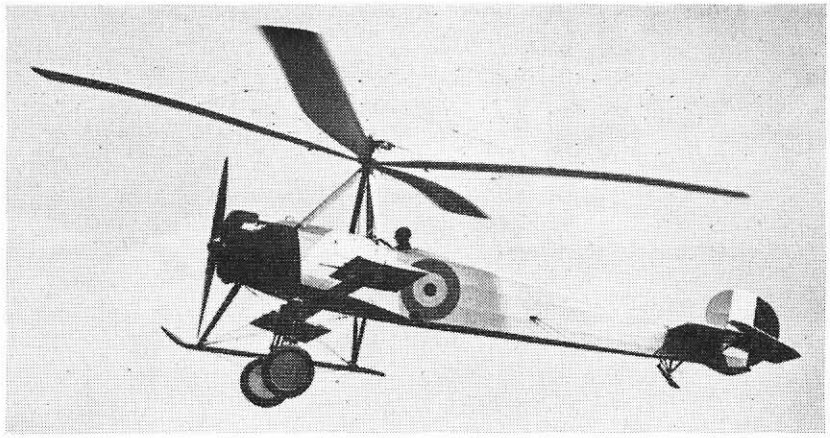
**Weights:* (landplane) Tare weight 4,233 lb. All-up weight 7,430 lb.
(seaplane) Tare weight 4,684 lb. All-up weight 7,871 lb.

**Performance:* (landplane)
Maximum speed 135 m.p.h. Cruising speed 105 m.p.h.
Initial climb 770 ft./min. Ceiling 13,700 ft.
Range 650 miles
(seaplane)
Maximum speed 130 m.p.h. Cruising speed 100 m.p.h.
Initial climb 640 ft./min. Ceiling 11,000 ft.
Range 400 miles

*Avro 572 Buffalo II

Production: One aircraft only, Avro 571 Buffalo I *G-EBNW*, c/n R3/BTC/30021, rebuilt as Avro 572 Buffalo II in 1927, converted to seaplane at Hamble and transferred to the M.A.E.E., Felixstowe, in 1928 as *N239*





F. T. Courtney flying the Avro 574 (Cierva C.6C) 504K derivative at Hamble in June 1926.

Avro 574, 575, 586 and 587 (Cierva C.6C, C.6D, C.8V and C.8R)

Don Juan de la Cierva, Spanish inventor of the world's first practical rotating wing, slow landing, non-stalling aircraft, started experimenting at Madrid in 1920 with a converted 1911 Deperdussin monoplane. He called this the Cierva C.1, but it would not fly. Problems of control arising from unbalanced lift also led to the failure of his C.2 (Hanriot fuselage) and C.3, but in 1922–23 he enjoyed limited success with C.4 and C.5. The Spanish Government became interested and advanced money which enabled Cierva to build his C.6A single seat research machine. This was basically an Avro 504K (110 h.p. Le Rhône) with a wider-than-standard undercarriage, without mainplanes and fitted instead with a four bladed articulated rotor (Göttingen 429 section) mounted on a pylon of steel tubes. The rotor was not engine driven but was kept in motion purely by the forward speed of the machine, a characteristic which led Cierva to invent the name 'autogiro'. Directional control was by a normal 504K rudder but the elevator was horn balanced and the ailerons, mounted on outriggers, were standard Bristol Fighter units. For later trials an early pre-production 504N oleo undercarriage was obtained from Avros.

Construction took place at the Military Aircraft Works, Madrid, and the C.6A was first flown at Cuatro Vientos by Lt. A. Gomez Spencer of the Spanish Flying Corps in May 1924. Experiments continued until December 9 when Capt. J. Loriga reached an altitude of 650 ft. in the course of a test flight, made an almost vertical descent and landing, and remained in perfect control at a forward speed of only 15 m.p.h. The top speed was estimated at a useful 68 m.p.h. and on December 12 Loriga made the now historic first

autogiro cross country flight of 7½ miles from Cuatro Vientos to Getafe, scene of Cierva's earlier tests with the C.1. An almost exactly similar 504K derivative, the Cierva C.6B (110 h.p. Le Rhône) was flown at Cuatro Vientos by Loriga in 1925.

At the invitation of H. E. Wimperis, Director of Scientific Research at the Air Ministry, Cierva took the C.6A to England where Capt. F. T. Courtney convincingly demonstrated it to a distinguished Farnborough gathering on October 15, 1925. As on all early autogiros, the length of take-off run was considerably reduced by spinning the rotor with ropes. Extensive tests at the R.A.E. by Sqn. Ldr. R. A. de Haga Haig A.F.C. and exhibition flights by Courtney before French officials at Villacoublay, near Paris (January–February 1926), led the British Air Ministry to order two similar machines from A. V. Roe and Co. Ltd. to Contract 680624/26.

Built at Hamble under designations Cierva C.6C (Avro 574) and C.6D (Avro 575), they were similar to the C.6A and B with ailerons on outriggers, but had 130 h.p. Clerget engines instead of Le Rhônes. The C.6C, first flown at Hamble by Courtney on June 19, 1926 in R.A.F. markings without serial number, flew as *J8068* before King George V at the Hendon R.A.F. Display with the same pilot on July 3. Stub wings (with ailerons) were later added in an attempt to relieve the rotors of part of the load in forward flight but although successful flights were made at Worthy Down on January 1, 1927 fatigue at the blade roots, caused by rigidity of the blades in the plane of rotation, resulted in the loss of a blade in flight at Hamble six days later. The machine crashed from 120 ft. but Courtney was only slightly hurt and



The Avro 575 (Cierva C.6D) with four bladed rotor, Hamble 1927. (*Photo courtesy of the Royal Aeronautical Society.*)



The Avro 587 (Cierva C.8R) flying over the Avro 586 (Cierva C.8V) at Hamble in 1927. (*Topical Press Photo.*)

the rudder survived to be fitted eventually to a later type, the C.8L Mk. I.

Historically important as the first two seat autogiro, the Avro 575 (or Cierva C.6D), was first flown with a four bladed rotor but without marks by F. T. Courtney at Hamble on July 29, 1926. Next day Cierva became the first passenger to fly in a rotating wing aircraft and on September 5 the noted German pilot Ernst Udet flew it at Templehof, Berlin, whither it had been taken by surface transport. On its return it was remodelled as the Cierva C.8R (Avro 587) with tapered paddle-shaped rotor blades of increased chord and incorporating drag hinges to decrease the risk of fatigue failure at the roots. Stub wings were also fitted. Work was completed on October 15 and H. J. 'Bert' Hinkler flew it early in 1927 with an experimental large area three bladed rotor and in September that year with an exploratory two bladed unit which set up excessive vibration and was hastily removed.

In 1926 the autogiro research programme had also been joined by the two seat Avro 552A slave aircraft *G-EAPR* (180 h.p. Wolseley Viper) stripped of wings and equipped with a similar rotor and control system to the C.8R. Tested initially by Hinkler this machine was designated C.8V (Avro 586). Main differences from the C.8R were the dorsal fin, a C.G. adjustment which permitted it to be flown solo from the front seat, and eventually a rotor with reduced blade chord which much improved the performance. Later it was equipped with a primitive tricycle undercarriage and in January 1927 with a four wheeled chassis. The original two wheeled undercarriage was replaced in August 1927 and in the following month the machine was allotted registration

G-EBTX as a civil aircraft. Hinkler flew it to Croydon and back for demonstrations on October 20, 1927 but in 1930 it was reconstructed at Hanworth as an Avro 552A once more, a unique event described in the appropriate chapter.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Spanish Military Aircraft Works, Getafe Aerodrome, Madrid

Power Plants:
(C.6A and C.6B) One 110 h.p. Le Rhône
(C.6C, C.6D and C.8R) One 130 h.p. Clerget
(C.8V) One 180 h.p. Wolseley Viper

Dimensions, Weights and Performances:

	Avro 574 (C.6C)	Avro 575 (C.6D)	Avro 587 (C.8R)	Avro 586 (C.8V)
Rotor diameter	36 ft. 0 in.	36 ft. 0 in.	39 ft. 8 in.	39 ft. 8 in.
Length	34 ft. 4⅛ in.	—	—	—
Tare weight	1,490 lb.	1,915 lb.	1,637 lb.*	2,005 lb.**
All-up weight	—	—	2,212 lb.	2,768 lb.
Initial climb	—	—	—	270 ft./min.
Rotor speed	140 r.p.m.	—	—	—

*1,676 lb. with large area three bladed rotor 10.6.27.
**1,994 lb. with four wheeled undercarriage 15.1.27.

Production:

Constructor's No. and Markings	*Type*	*Details*
(*a*) By the Spanish Military Aircraft Works		
nil	C.6A	First flown at Cuatro Vientos 7.23, to England 1925
nil	C.6B	First flown at Cuatro Vientos 1925
(*b*) By A. V. Roe and Co. Ltd.		
nil *J8068*	C.6C	First flown 19.6.26, crashed at Hamble 7.2.27
5114 nil	C.6D	First flown 29.7.26, rebuilt 1927 as the C.8R
5114 *G-EBTW*	C.8R	Registered 9.9.27, scrapped 1929
5113 *G-EBTX*	C.8V	Formerly Avro 552A *G-EAPR*, registered 9.9.27, reconverted to Avro 552A in 1930 as *G-ABGO*



The Avro 587 (Cierva C.8V) with experimental four wheeled undercarriage, January 1927. (*Photo courtesy of the Royal Aeronautical Society.*)



Avro 581 Avian prototype with 70 h.p. Armstrong Siddeley Genet built for the 1926 Two Seat Light Aeroplane Trials.

Avro 581 Avian Prototype

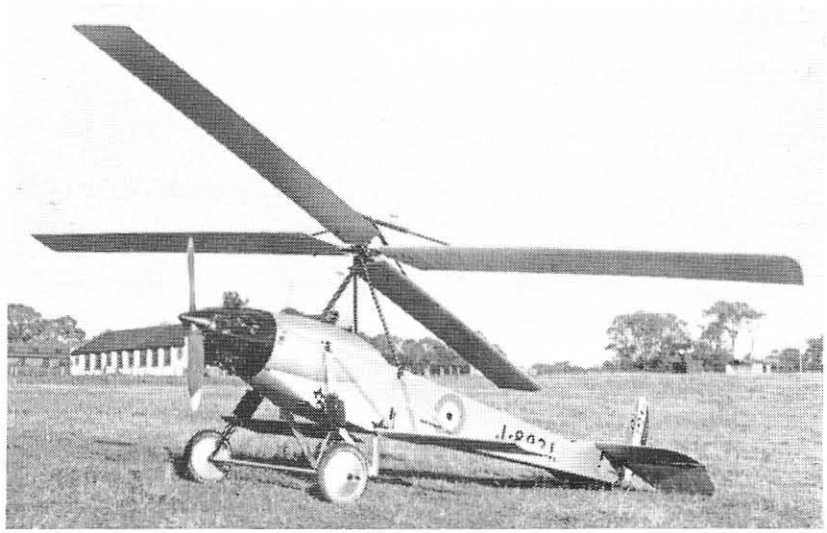
In January 1926 the Air Ministry placed a further autogiro contract with Avros, this time for two machines of new design, not derived from the 504K. The smaller of the two, designated Avro 576, had a slim plywood covered, square section, fuselage without top decking in the rear but of orthodox proportions forward to accommodate a single pilot. A 70 h.p. Armstrong Siddeley Genet radial engine was faired into the flat sided fuselage by large external bulges, that on the port side housing the oil tank. A wide track, N-type oleo undercarriage gave exceptional stability on the ground, and control was by ailerons on braced outriggers in conjunction with normal rudder and elevators. There was no fin and the oval shaped rudder, similar to that fitted to the Avro 558, was a more refined version of the famous comma type. The pylon consisted of three steel tubes mounted about the cockpit and supporting a 30 ft. diameter rotor having four untapered blades coupled to a fixed head by drag hinges.

Numbered *J8931* and known as the C.9 in the Cierva series, the Avro 576 was first flown by Hinkler at Hamble in September 1927. Half-length untapered blades were tried at Farnborough in September 1928.

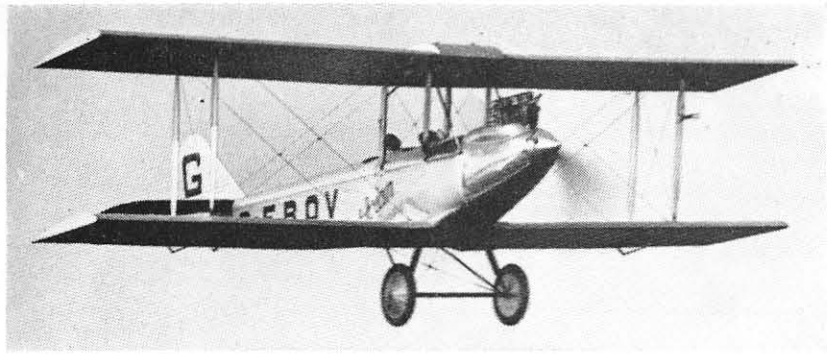
A second fuselage, identical at the forward end, but with two seats and a curved rear decking, was completed at Hamble as an orthodox biplane for the *Daily Mail* two seat light aeroplane trials held at Lympne September 10–18, 1926. With an eye on the club and private owner market then being opened up, designer Roy Chadwick retained the 70 h.p. Genet because it was the most powerful unit available within the maximum engine weight allowance of

170 lb. Known as the Avro 581 Avian and registered *G-EBOV*, the machine was chiefly remarkable for a very low structural weight which gave a tare weight to all-up weight ratio of less than 0·5. For competition purposes the Avian had a generous wing area of 294 sq. ft., and the whole single bay wing structure was of the simplest possible concept and used thick section mainplanes with square cut tips. The centre section was mounted on four tall wooden struts which gave an exaggerated mainplane gap of 5 ft. 3 in. Ailerons were fitted only to the lower plane and fuel was carried in the front fuselage to leave the upper mainplane unencumbered. For ease of housing and to comply with competition rules, the wings folded about the rear spar to reduce the overall width to 9 ft. 6¼ in. Folding was by quick release bolts in the front root end fittings but temporary jury struts were necessary to support the front corners of the wing cellule. The undercarriage was of new design with the front legs sprung by rubber blocks in streamlined fairings. Large diameter wheels with narrow tread high pressure tyres were fitted to a steel cross axle, while for ease of handling during the folding and 'housing' tests, a small detachable roller was clamped to the tail skid.

The Avian was a most promising entry in which H. J. Hinkler flew 1,074 miles in three days and despite a leaking fuel tank, gained second place in three of the six tests. He averaged 68·75 m.p.h. for the 312 mile, three lap cross country to Shoreham on September 12; 69·75 m.p.h. for three laps of the 366 mile Hastings–Eastbourne circuit on September 13; and 78·63 m.p.h. over the 396 mile six lap course via Dover, Manston, North Foreland and



The Avro 576 (Cierva C.9) autogiro *J8931* at Hamble, September 1927. (*Photo courtesy of the Royal Aeronautical Society.*)



H. J. Hinkler flying the prototype Avian in Avro 581A form with A.D.C. Cirrus II engine. (*'Flight' Photo.*)

Reculver on September 14. Unfortunately the machine was eliminated when the duralumin drive of the single magneto sheared and Hinkler forced landed at Iford Hill, near Lewes. As partial compensation Hinkler won the Society of Motor Manufacturers and Traders Race and £200 on September 18 by averaging 90 m.p.h. over six laps of the Lympne course.

A proposal to remove the biplane wing structure and enter the Avian for the Grosvenor Trophy Race that afternoon as a strut braced, low wing monoplane under the designation Avro 588, did not materialise. Nor did a further suggestion to equip it with floats as the Avro 589. In actual fact the machine returned to Hamble where the span was reduced from 32 to 28 ft. and the nose was slightly lengthened to take an 85 h.p. A.D.C. Cirrus II in-line engine, gravity fed from a large centre section tank, to support which additional sloping struts were fitted. To compensate for the extra side area forward it was necessary to fit a triangular fin and enlarged unbalanced rudder. In this form the Avian was redesignated Avro 581A and sold to Hinkler who flew it at the Bournemouth Easter Meeting, April 15–18, 1927 winning the 'Kill Joy Stakes' at 89·0 m.p.h., the Hotels Handicap at 90·0 m.p.h. and the Holiday Handicap at 93·0 m.p.h. Limited production initially envisaged under the type number Avro 581B, then began at Hamble in a sufficiently modified form to warrant an entirely new designation. These machines are therefore dealt with in their own chapter under designation Avro 594 Avian I.

In the following July the Avian prototype *G-EBOV* was fitted with a wide track, divided undercarriage of Hinkler's own invention which moved back as the wings were folded, imparting the twofold advantage of keeping the wheels under the C.G. so that the tail was easier to lift with the wings folded, and of lowering the engine to make it more accessible for maintenance. Later a long range tank was fitted in the front cockpit and Hinkler left Croydon at 5.27 a.m. on August 27, 1927 to fly 1,200 miles to Riga in Latvia in 10¾ hours, the longest non-stop flight by a light aeroplane up to that time. After



G-EBOV at Croydon in February 1928 with the special wings from the Avro 594C altitude machine, and wide track undercarriage in readiness for Hinkler's Australia flight.

an inspection by the Latvian Air Force which ultimately led to an order for Avian trainers, and the completion of business for Wm. Beardmore Ltd., Hinkler flew back to Hamble in easy stages.

This flight provided fuel consumption figures which convinced Hinkler that '*OV* was capable of taking him home to Australia. A more rugged, non-folding divided undercarriage, the R.A.F.28 section Avro 594C wings from the altitude record machine (see page 244) and Fairey metal airscrew were then fitted and the type number amended to Avro 581E. Hinkler took off from Croydon at 6.48 a.m. on February 7, 1928 and arrived at Darwin 15½ days later, having covered 11,005 miles in a flying time of 128 hours with night stops at Rome, Malta, Tobruk, Ramleh, Basra, Jask, Karachi, Cawnpore, Calcutta, Rangoon, Victoria Point, Singapore, Bandoeng and Bima. He undertook a further 200 hours of touring in Australia with his wife as passenger, reached Sydney on March 10 and arrived home at Bundaberg in April. They left almost immediately to make the long flight across the Bass Strait and met W. N. Lancaster and his Avian III "Red Rose" (see page 245) at Launceston on May 7. For these outstanding achievements Hinkler was awarded the Britannia Trophy for a second time and was made an Hon. R.A.A.F. Squadron Leader.

The famous Avian prototype was not registered in Australia and although still in good condition after more than 35,000 miles flying, was placed in Brisbane Museum still in its British marks *G-EBOV* to remain a permanent monument to its immortal owner and to Chadwick's design genius.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants:
(Avro 576) One 70 h.p. Armstrong Siddeley Genet
(Avro 581) One 70 h.p. Armstrong Siddeley Genet
(Avro 581A and E) One 85 h.p. A.D.C. Cirrus II

Dimensions, Weights and Performances:

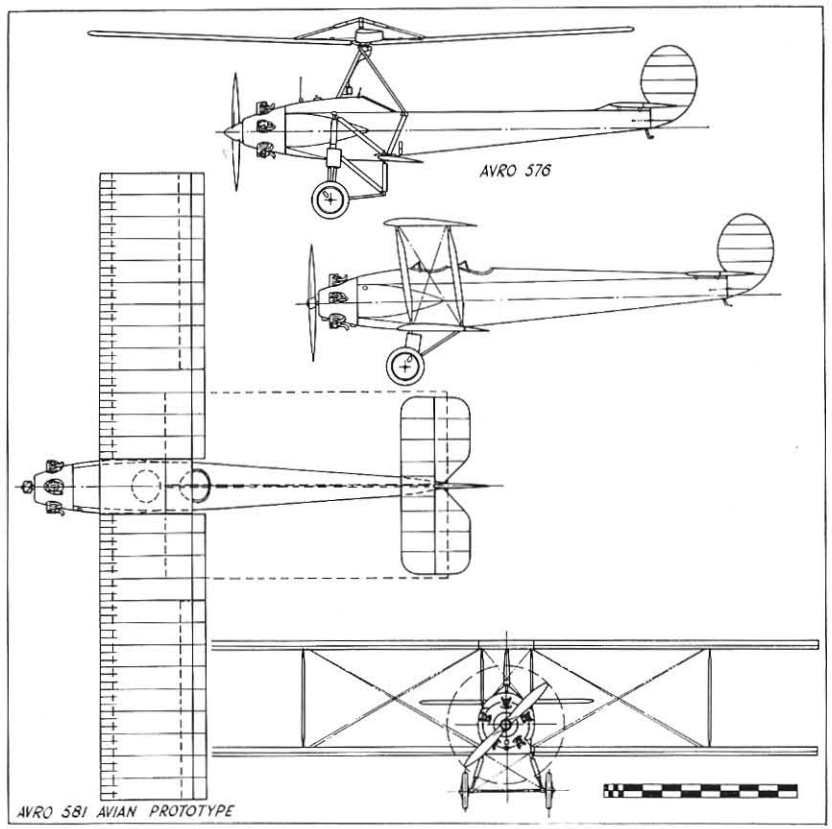
	Avro 576	Avro 581	Avro 581A	Avro 581E
Span	30 ft. 0 in.*	32 ft. 0 in.	28 ft. 0 in.	28 ft. 0 in.
Length	24 ft. 6 in.	24 ft. 3 in.	24 ft. 3 in.	24 ft. 3 in.
Height	—	8 ft. 3 in.	8 ft. 6 in.	8 ft. 6 in.
Wing area	—	294 sq. ft.	245 sq. ft.	245 sq. ft.
Tare weight	816 lb.	695 lb.	—	—
All-up weight	1,073 lb.	1,600 lb.	—	—
Maximum speed	—	70 m.p.h.	—	—

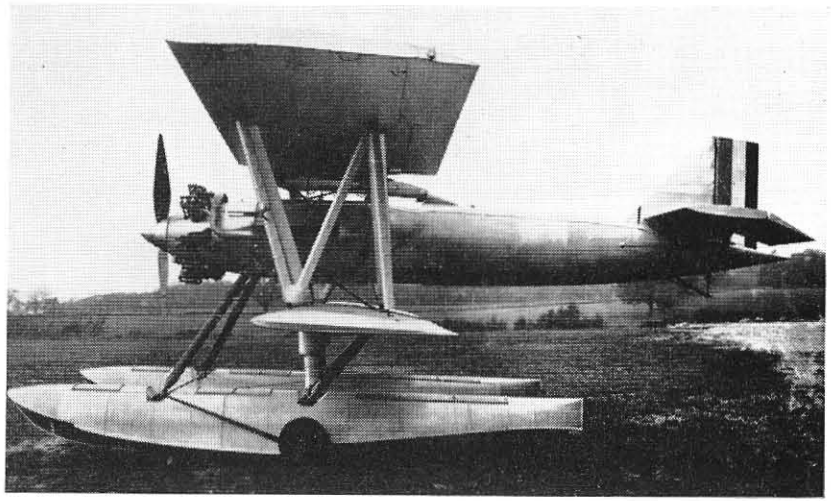
*Rotor diameter.

Production:

Avro 576 One aircraft only, *J8931*, to Contract 698108/26, first flown at Hamble 1927, to the Science Museum 1.30

Avro 581 One aircraft only, *G-EBOV*, c/n 5116, registered to A. V. Roe and Co. Ltd. 7.7.26, C. of A. issued 8.9.26, converted to Avro 581A and sold to Hinkler 7.4.27, converted to Avro 581E and flown to Australia 2.28, s.o.r. 1.30, preserved in Brisbane Museum





The first Avro 584 Avocet *N209* with triangular fin and unbalanced rudder.

Avro 584 Avocet

Designed to Air Ministry Specification 17/25 issued in June 1926, the Avocet was a single seat fleet fighter of all metal, stressed skin construction powered by a 180 h.p. Armstrong Siddeley Lynx IV supercharged engine driving a metal airscrew. The fuselage was a constant diameter light alloy tube of riveted duralumin sheets, tapering only at the tail, and positioned at mid-gap by a number of steel struts. It was a single bay sesquiplane with N-type interplane struts and full span, Frise-type ailerons on the upper mainplane only.

The wing structure did not fold but was designed for quick dismantling and stowage aboard ship. Erection was simply a matter of bolting the halves of the upper wing together and attaching the lower wing panels to the bottom centre section. There were no rigging problems, wing bracing being of the Warren truss type without wires.

Interchangeable wheel and float undercarriages made the Avocet equally suitable for operation from the deck of an aircraft carrier or for catapulting from a cruiser. Catapult points were built into the fuselage, a special headrest added, and a pick-up ring fitted ahead of the cockpit for use when the crane retrieved it from the water. Armament consisted of two Vickers guns, one on each side of the fuselage in a special trough and firing forward through the airscrew.

The Avocet was not ordered into production as on such low power its performance was unimpressive and only two prototypes, *N209* and *N210*,

were built. They were identical except for the vertical tail surfaces, *N209* having a large triangular fin and unbalanced rudder while *N210* had a truncated fin and large horn balanced rudder. For manufacturer's trials they were completed initially as landplane and seaplane respectively, *N209* flying at Hamble on wheels in December 1927 and *N210* on floats in the following April. Wheels were fitted to *N210* in June 1928 and both Avocets went to Martlesham to be evaluated for the Fleet Air Arm in February 1929. In September of that year *N210* was placed on the strength of the High Speed Flight and went to Calshot as a practice machine for Schneider Trophy pilots.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plant: One 180 h.p. Armstrong Siddeley Lynx IV

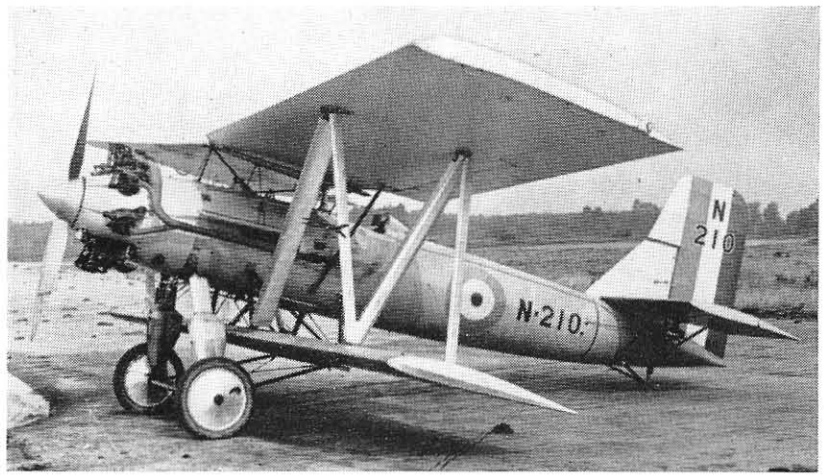
Dimensions:

	Span 29 ft. 0 in.	Wing area 308 sq. ft.
(*N209* floats)	Length 27 ft. 6 in.	Height 11 ft. 10 in.
(*N210* wheels)	Length 24 ft. 6 in.	Height 11 ft. 8⅜ in.

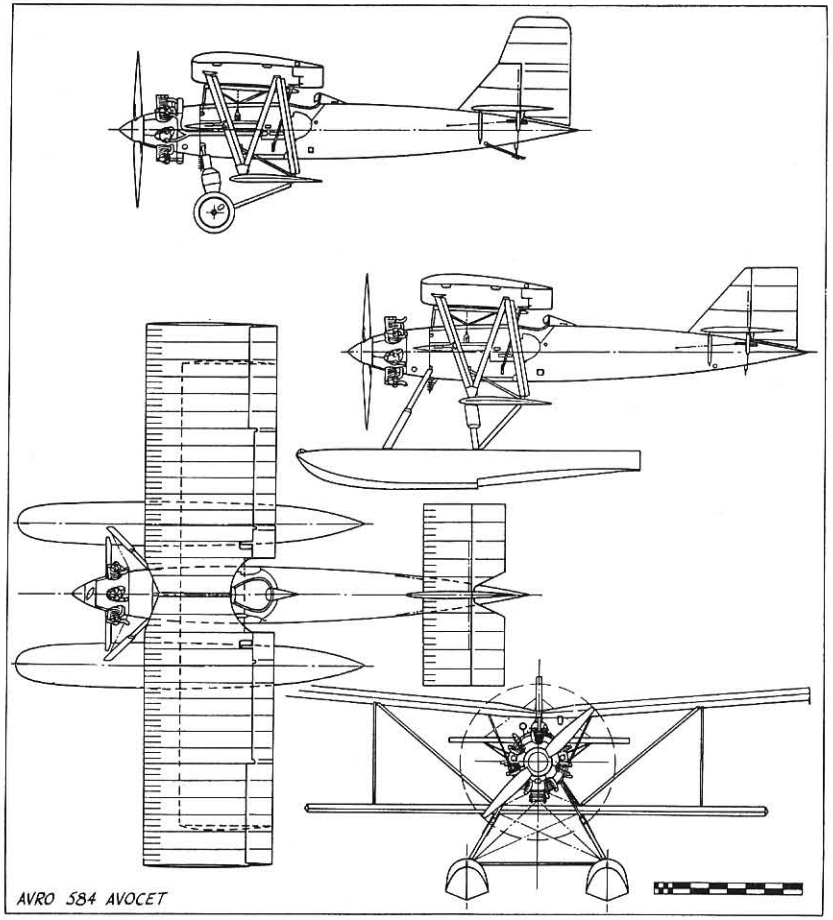
Weights:

(*N209* landplane)	Tare weight 1,621 lb.
(*N210* landplane)	Tare weight 1,669 lb.*
	All-up weight 2,495 lb.

*1,678 lb. at Martlesham trials.



The second Avocet *N210* with small fin and large balanced rudder.





The R.A.E. Aero Club's Avro 594 Avian I.

Avro 594 Avian

A production version of the Avian prototype (Cirrus II), laid down as the Avro 581B, eventually appeared in April 1927 as the Avro 594. Only two were built, *G-EBQN* for the Royal Aircraft Establishment Aero Club, Farnborough, and a demonstrator '*QL*, flown in the 1927 King's Cup Race and at the Zürich International Meeting by Dudley Watt. Later it was presented to the Lancashire Aero Club to replace Avro Gosport *G-EBNE*. Aimed at the private owner and flying club market, they were considerably strengthened versions of the original and were later known as Avian Is. They resembled the prototype in Avro 581A form with folding wings and narrow track, cross-axle undercarriage, but had slightly rounded wing tips and at last forsook the Avro circular rudder.

Both '*QN* and '*QL* were certificated in time to compete at the Bournemouth Easter Meeting, April 15–18, 1927 piloted by Wing Cdr. W. Sholto Douglas and F/Lt. J. A. Gray respectively, the latter coming second to Hinkler's prototype in the Holiday Handicap Race at 89·5 m.p.h. They raced several times that year but by May 1927 were already outmoded by *G-EBRC*, first of nine Avro 594 Avian IIs which featured Hinkler's patent folding, wide track, divided undercarriage mounted on small triangular stub wings. The thrust line of the Cirrus II engine was lowered still further to decrease drag and improve forward view. As before, the fuselage was a flat sided plywood box needing none of the periodic trueing up of the wire braced girder type.

Piloted by Dudley Watt *G-EBRC* won the altitude race at the Copenhagen Flying Meeting, Kastrup, on September 4, 1927 by reaching 12,750 ft. in 90 minutes, but on the return flight to Hamble compass trouble put him south of track so that '*RC* ran out of fuel and met a watery end off Woody Point, Ventnor, Isle of Wight. The third Avian II, '*RS*, was built for Mrs. S. C. Elliott-Lynn whose efforts to publicise the type amounted almost to a crusade.

Leaving the Avro aerodrome at Woodford at 03.20 hrs. on July 19, 1927 she covered 1,300 miles round England with 79 landings (many of them touch-and-go, often in fields) via Sealand, Bournemouth, Lympne, Norwich, Nottingham and Leeds, finally landing at Cramlington, Newcastle at 21.27 hrs. In the next few weeks she completed a 3,000 mile European tour to Poland and back which ended with a flight from Breslau to Bromley, Kent, where the fuel ran out. Despite these exertions Mrs. Elliott-Lynn and *'RS* were at the Zürich International Meeting August 12–21 and on a tour of Scotland for the Air League in September.

Next off the production line was *G-EBSD*, powered by the second of the hand-made 100 h.p. Avro Alpha radial engines as a 'dark horse' for Hinkler to fly in the King's Cup Race at Hucknall on July 30, 1927. With this engine it was designated Avro 594A Avian II but a cracked carburettor casing eliminated it from the race. In furtherance of the Avian proving and publicity programme, R.A.F.28 section wings with rounded tips were fitted and in this form, as the Avro 594C, it was flown to a lightplane record height with passenger of 19,200 ft. by Mrs. Elliott-Lynn on October 8. The Alpha engine ran successfully at full throttle for two hours during the climb but fog formed over Woodford and the flight terminated in a field at Frodsham, Cheshire. In the summer of 1928 *'SD* was used for joyriding in Somerset by Taxiplanes Ltd. prior to a short period in private ownership.

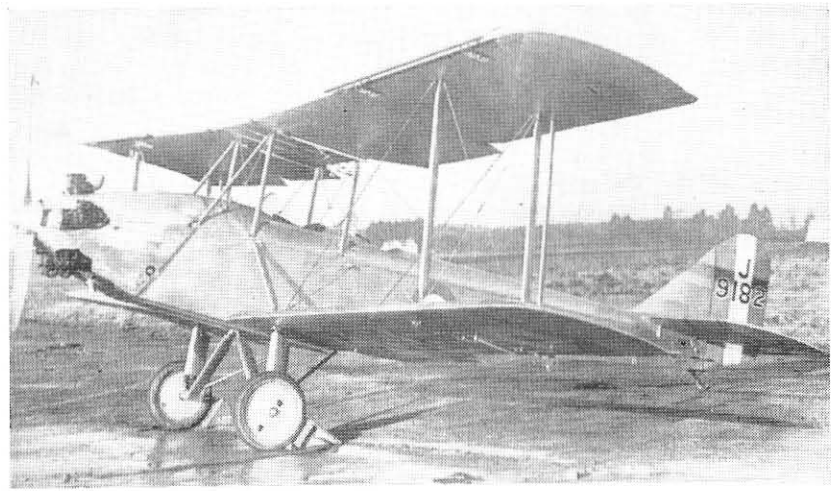
Decorated in red and gold, one of the Cirrus engined Avian IIs was presented to the Aero Club of South Africa by the Shell Company and made many notable flights with the Cape Town Flying Club, first as *G-UAAC* and later as *ZS-AAC*. Three with 75 h.p. Armstrong Siddeley Genet II radials were supplied to Australian order, *G-AUGA* for E. W. Percival and *G-AUFY*



The Lancashire Aero Club's Avian II fitted with Hinkler's patent folding undercarriage.



G-EBSD in single seat form as the Avro 594C with Avro Alpha engine and altitude record mainplanes.



J9182, c/n 125, the R.A.F.'s sole Avro 594B Avian III. (80 h.p. Armstrong Siddeley Genet II.)

and *'FZ* for Wings Ltd. who ran a flying school at Broken Hill, N.S.W. *G-AUFY* was later fitted with a 105 h.p. Genet Major I from the crashed Avro 619 Five *VH-UNK* (see page 276).

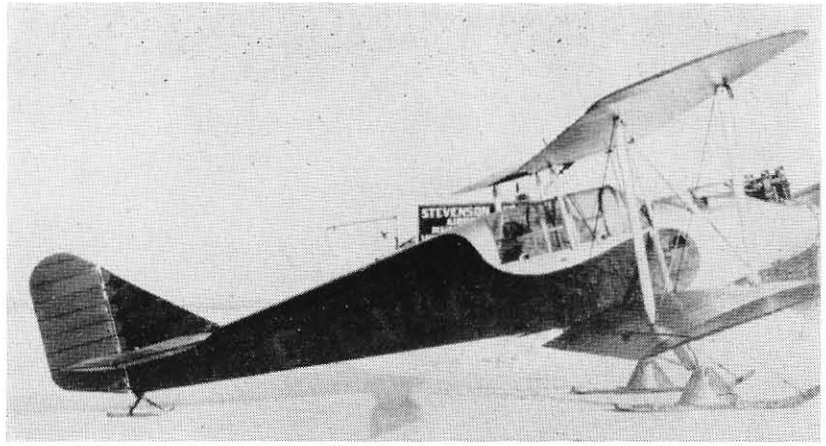
Avian development moved swiftly to the Mk. III, the first being *G-EBTU*, taken from the Avian II production line in September 1927 to be modified and fitted with overload fuel tanks for Capt. W. N. Lancaster's flight to Australia. Apart from slim tubular steel interplane and centre section struts the Avian III airframe was identical with that of its predecessor. A scheme to fit R.A.F.15 section wings under the designation Avro 600 was discarded and

the chief difference between the two marks lay in the engine installation, the Cirrus II now being set still lower to bring the cylinder heads into line with the fuselage decking to permit the use of improved cowlings merging cleanly into a conical spinner. Named "Red Rose", county symbol of Lancashire, the Avian III 'prototype' had a considerable career. Accompanied by Mrs. Keith Miller, Capt. Lancaster left Croydon on October 14, 1927 and made good time until forced down at Ur of the Chaldees with a sheared magneto drive. Persistent magneto trouble, serious damage when a blocked fuel line caused engine cut on take-off at Muntok in the Dutch East Indies on January 10, 1928 (followed by shipment back to Singapore for repairs), delayed their arrival at Darwin until March 19. They were passed by Hinkler in the record breaking Avian prototype *'OV* at Singapore but met him again when both Avians were at Launceston, Tasmania, on May 7, *'TU* having crossed the Bass Strait from Melbourne in 6½ hours on April 29. "Red Rose" remained in Australia as *VH-UTU* under several ownerships until burned out on the ground at Singleton, N.S.W., in 1936.

One more pre-production and 31 production Avian IIIs were built, including *G-EBUG* which Lady Heath (the former Mrs. Elliott-Lynn) shipped to South Africa in December 1927 for a leisurely solo flight from the Cape to Croydon, March–May, 1928. She later sold it in the U.S.A. to Miss Amelia Earhart, probably as *NC7083*. A notable flight in the opposite direction began on July 29, 1928 when Lt. P. Murdoch left Croydon to deliver Avian III *G-EBVU* to the *Cape Argus*. Such was the Avian's sturdiness and reliability that he completed the flight without incident on August 12 and straightway flew the machine back as far as Bulawayo. Final Avian IIIs



G. H. Storck's Avian IIIA seaplane *NX6663*, c/n 169, "Seattle Spirit" at Hamble in September 1928.



Originally supplied to Western Canada Airways on floats in 1928, *G-CANM*, c/n 128, was later flown on skis with cabin top and built-up rear fuselage.

were *J9182* tested at Martlesham March–May 1929 and later attached to No. 32 Squadron, Kenley; six seaplanes for Western Canadian Airways Ltd., Winnipeg; and *G-EBXJ* for H. J. V. Ashworth, Tollerton.

In preparation for the King's Cup Race at Brooklands on July 20–21, 1928 E. W. Percival's *G-EBYR* and two works Avians *'YO* and *YP* were fitted with the A.D.C. Company's newest engine, the 90 h.p. Cirrus III, under the designation Avian IIIA. They had little success but Percival and Lady Heath were 2nd and 4th respectively in *'YR* and *'ZM* at the French Light Aeroplane Trials at Orly, September 10–21, 1928. Some 58 Avian IIIAs were built, including 16 for the American Avian distributors, Air Associates Inc. of New York. One of these, licence number *392*, owned by well-known aircraft designer M. A. Northrop, was flown by film star Lya de Putti, while *7900*, owned by N. C. Durrant, was flown at Detroit, Michigan, by Ford Motor Company pilots. Considerable sales were also effected in the Commonwealth and one machine evaluated by the South African Air Force at Roberts Heights was responsible for a substantial order for a later mark. *VR-TAG*, acquired by the Director of Surveys, Tanganyika, was the first of a small fleet of miscellaneous Avro aeroplanes which completed the aerial mapping of that territory 1928–31. One Avian IIIA, intended as *G-AAAP*, was fitted with metal floats and sold to American owner G. H. Storck as *NX6663* "Seattle Spirit" for an ambitious 27,000 mile world flight via India, the Far East and the Aleutians. He left Southampton Water on September 15, 1928 but overturned on take-off from Bastia, Corsica, on September 22. The machine was afterwards shipped to the U.S.A. and later flew as *NC6663*.

To cover seaplane versions the Avian designation system was extended to include type number 605, the pure Avro 605 representing the float-equipped Cirrus engined Avian III or IIIA. Type numbers 605A and 605B were

reserved for Alpha and Genet engined machines but were never used. Avian IIIA landplane *G-EBZD*, kept at Croydon initially by Airways Publications Ltd., was unique in having an 80 h.p. Genet II, and in common with all Genet Avians, whatever the mark, was designated Avro 594B.

Later in 1928 the undercarriage radius rods were repositioned forward of the main legs and attached to a common anchorage under the mid-point of the engine bulkhead. This produced a very robust structure, much superior to the old, which became standard and was also fitted to a number of Avian IIs and IIIs when they came up for overhaul and modernisation. With this undercarriage, and horn balanced ailerons (and at a later date with wide chord strut fairings and low pressure Goodyear Airwheels), the wooden Avian became the Mk. IV and reached the limit of its development.

Avian IV production was intiated by three machines, *G-AAAT* with Cirrus III for A.D.C. Aircraft Ltd.; *G-AADL* with 80 h.p. Genet II for J. D.



Avian IV *G-AADL*, c/n 182, in early form with 80 h.p. Armstrong Siddeley Genet II.



The Cirrus Engine Company's Avian IV *G-AAAT*, c/n 172, with prototype 105 h.p. Cirrus Hermes I.



The Alpha Club's rebuilt Avro 594A Avian II *G-ADEO* flying near Hamble in 1935.

Siddeley whose companies held a controlling interest in A. V. Roe and Co. Ltd.; and *G-AABX* "Comète" with Cirrus III for Lancashire cricketer P. T. Eckersley. Almost all other Avian IVs, amounting to some 90 aircraft, were fitted initially with the Cirrus III although several acquired 105 h.p. Cirrus Hermes Is or 115 h.p. Hermes IIs at a later date and in one instance (*G-AAHK*, flown by J. C. Cantrill for Pinchin, Johnson and Co. Ltd.), a 100 h.p. de Havilland Gipsy I. Handley Page slots were an optional extra.

Flying *G-AAAT*, T. Neville Stack got both the Avian IV and his company's 105 h.p. Hermes I engine off to a good start by covering the 620 miles between Croydon and the Berlin Aero Show in the record nonstop time of 4 hr. 52 min. on October 19, 1928. Only a handful of these machines were absorbed by the British market and the majority went overseas, notably to Air Associates Inc. for erection in New York, and to the Whittlesey Manufacturing Co. of Bridgeport, Connecticut. Many imported Avians, subject of Group 2 Approval ATC 2–39 dated October 11, 1929, survived until at least 1941, often with locally contrived engine installations, as for example *NC6882* (100 h.p. Wright Gipsy) and *NX603E* (95 h.p. Menasco B-4). Two Avro 594B Avian IVs *CF-CAQ* and *'AR* with Genet II engines were used by the Ottawa Flying Club, the first being presented by Avro director J. D. Siddeley (later Lord Kenilworth), owner of a similar machine *G-AADL*.

Avian IV sales embraced Argentina, Australia, Brazil, Mexico, Norway, South Africa and Spain. *X-CRIA* "Amoy", one of 14 imported into China by the S.K. Engineering Company to form initial training equipment of the Chinese Naval Air Service at Amoy, Fukien Province, was flown from Croydon to Shanghai by Messrs. Johannsen and Wen Lin Chen. It arrived at Shanghai on May 28, 1929 the only trouble experienced being a forced

landing at Swingate Downs, Dover, soon after the start on March 2. Another was flown to Norway by Alf Gunnestad in June 1929 as *N-38* and later operated as *LN-ABF* with the 1933–34 Norwegian Antarctic Expedition. One survey flight discovered and named Princess Astrid Land. Twenty years later in 1949 *SE-ADT* (formerly H. B. Chantrey's Heston-based *G-AAHD*) and *SE-AEM* (ex *G-EBXJ*) were still flying in Sweden.

In 1929 an Avian IV fuselage was used at Hamble in the construction of the Cierva C.17 autogiro (Avro 612). It was not successful but work continued with the Avro 612 Hydrogiro and the Cierva C.17 Mk. II, both with Avian fuselages and Avro Alpha engines. It is not certain if the latter was completed and flown, most of its life being spent as one of Air Service Training Ltd.'s instructional airframes at Hamble. A team of A.S.T. engineers rebuilt it in 1935 as the Alpha engined Avian *G-ADEO*. Apart from narrow chord struts and the Mk. IV undercarriage it was equivalent to the original Avro 594A Avian II but its owners (the 25 strong Alpha Club) called it the Alpha 25 with constructor's number A.25/1.

At the outbreak of the Second World War, ten wooden Avians were impressed by the R.A.F. for instructional use at Schools of Technical Training, and one Gipsy II Avian IV *VH-UKD* was similarly used by the R.A.A.F. The only British survivors were two which escaped war service, Cirrus Avian IIIA *G-EBZM* and Genet II Avian IIIA *G-ACGT*. Both were still in storage in 1963, the latter being that sold originally in Ireland as *EI-AAB*. It returned to Gatwick in May 1933, thus following a sister machine *EI-AAA*/*G-ABPU* which was repatriated in 1931 and flown in the 1932 King's Cup Race by J. F. Legard.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
The Whittlesey Body Co., Bridgeport, Connecticut, U.S.A.

Power Plants:
One 85 h.p. A.D.C. Cirrus II
One 80 h.p. Armstrong Siddeley Genet II
One 90 h.p. A.D.C. Cirrus III
One 95 h.p. Menasco B-4
One 100 h.p. Avro Alpha
One 100 h.p. de Havilland Gipsy I
One 100 h.p. Wright Gipsy
One 105 h.p. A.D.C. Cirrus Hermes I
One 105 h.p. Armstrong Siddeley Genet Major
One 115 h.p. A.D.C. Cirrus Hermes II

Dimensions:
Span 28 ft. 0 in.
Length 24 ft. 3 in (seaplanes) 25 ft. 0 in.
Height 8 ft. 6 in. (seaplanes) 9 ft. 6 in.
Wing area 245 sq. ft.

Weights and Performances:

	Avian II	Avian III	Avian IIIA and IV	Avian IIIA seaplane
Tare weight	907 lb.	875 lb.*	935 lb.	1,053 lb.
All-up weight	1,467 lb.	1,600 lb.*	1,435 lb.	1,600 lb.
Maximum speed	98 m.p.h.	97 m.p.h.	102 m.p.h.	97 m.p.h.
Cruising speed	82 m.p.h.	80 m.p.h.	87 m.p.h.	82 m.p.h.
Initial climb	—	650 ft./min.**	750 ft./min.	480 ft./min.
Ceiling	15,000 ft.	15,000 ft.**	18,000 ft.	13,000 ft.
Range	400 miles	400 miles	400 miles	400 miles

*"Red Rose" 930 lb. and 1,726 lb. respectively; standard seaplane 1,015 lb. and 1,600 lb.
**J9182 (Genet II) 330 ft./min. and 6,500 ft.; standard seaplane (Cirrus III) 400 ft./min. and 11,000 ft., maximum speed 91 m.p.h.

Production:

(a) Avro 594 Avian I (Cirrus II)

Constructor's No. and Registration		*C. of A. Issued*	*Details*
R3/AV/100	*G-EBQN*	12. 4.27	R.A.E. Aero Club, Farnborough, impressed 1.40
R3/AV/117	*G-EBQL*	12. 4.27	To Light Planes (Lancs.) Ltd.* 11.27 to replace Avro Gosport *G-EBNE*, rebuilt as Avian IV, crashed at Barton 18.11.33

(b) Avro 594 Avian II (Cirrus II)

R3/AV/118	*G-EBRC*	13. 5.27	Demonstrator, lost at sea off Ventnor, Isle of Wight 6.9.27
R3/AV/119	*G-EBRR*	14. 7.27	Light Planes (Lancs.) Ltd.*, crashed 1.29
R3/AV/120	*G-EBRS*	18. 7.27	Mrs. S. C. Elliott-Lynn, to Basle Air Transport 8.27, believed as *CH-202*
R3/AV/122	*G-UAAC*	25. 8.27	Aero Club of South Africa, later *ZS-AAC*
R3/AV/124	*G-EBTP*	1. 9.27	H. Hollingdrake, Woodford, to South Africa 2.29, believed as *G-UAAR*

(c) Avro 594A Avian II (Alpha)

R3/AV/121	*G-EBSD*	28. 7.27	Temporarily Avro 594C 10.27, Taxiplanes Ltd. 6.28, F. S. Lee 1.29, L. M. J. Balfour 1.30, crashed 1932, broken up at Hanworth 3.33

(d) Avro 594B Avian II (Genet II)

R3/AV/123	*G-AUGA*	22. 9.27	Initially to E. W. Percival, later *VH-UGA*, burned out at Essendon, V. 28.2.39
R3/AV/126	*G-AUFY*	1. 12.27	Initially to Wings Ltd., Broken Hill, N.S.W., fitted with Genet Major 1931, s.o.r. 8.41
R3/AV/127	*G-AUFZ*	1. 12.27	As *'FY* above, converted to Avian IV (Cirrus III), s.o.r. 12.47

(e) Pre-production Avro 594 Avian III (Cirrus II)

R3/AV/125	*G-EBTU*	23. 9.27	"Red Rose", sold in Australia 5.28 as *VH-UTU*, burned on ground at Singleton, N.S.W. 6.6.36
R3/AV/128	*G-EBTY*	23. 9.27	J. P. Drew; to Scottish Flying Club 10.28; D. K. Fairweather 1.29 (all Renfrew); R. E. Horrox, Nether Thorpe 10.34; rebuilt as Avian IV (Hermes II); Light Planes (Lancs.) Ltd.* 12.38; H. V. Armstrong, Woodford 8.39; impressed 12.39

*Trading as the Lancashire Aero Club.

(*f*) Production Avro 594 Avian III (Cirrus II)

Constructor's Numbers commencing R3/CN/101)	Aircraft markings
101–125	*G-EBUG, G-AUHC,* Señor Juan Acuna, *G-EBVA*, G-CAWI,* Argentine, *G-EBVI, M-CCAC, G-UAAS, G-IAAX, G-EBVU, 'VZ, 'WP, 'WK, G-CAUH, G-EBWR, 'WU, 'WW,* J. F. Costa, *G-AUHK, G-EBXD, M-CDAA, G-EBXE, 'XO, J9182***
127–133	*G-CANL–'NQ, G-EBXJ*

*Temporarily Avro 605 Avian seaplane.
**To Contract 787176/27 with Armstrong Siddeley Genet II serial number A.S.48.

(*g*) Production Avro 594 Avian IIIA (Cirrus III)

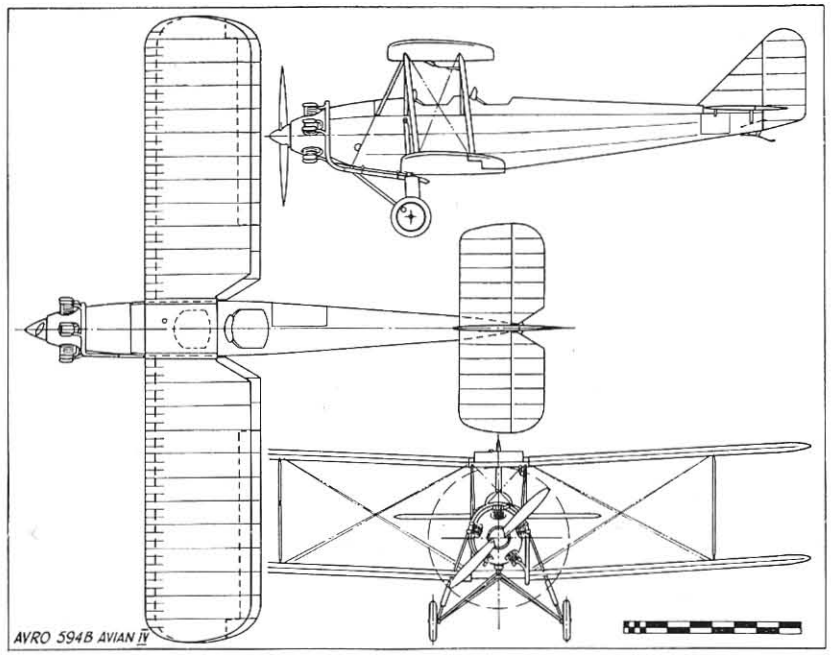
Constructor's Numbers	Aircraft markings
134–150	*G-EBYA,* Air Associates *NC6881, '82*, 7012, '13, 7154, '55, 7289, '90, 7625, G-AUHZ, 'IK, 'IL,* Air Associates *NC7869* and *392, G-CAQA, CF-AFQ*
151–171	*G-EBYM/M-CAAE, G-EBYN/M-CDDD, G-EBYO–'YR, M-CDAD,* Air Associates *NC7626,* Argentine, *G-UAAZ, G-EBZM, 'ZD**, G-NZEE, G-CAVB, G-AUHY,* South African Air Force, Air Associates *NC7900, G-UAAT, 'AU, G-AAAP/NX6663, EI-AAA**, 'AB***
173–177	*G-AABZ/VR-TAG, G-NZAV, G-UABB,* South Africa, *G-AAAU*
181	*G-AABU*
184–189	*G-AUJF, 'JG,* Air Associates *NC10075, '76, 367, '62*
192–193	*G-AUIU, 'IV*
198–200	*M-CPAA, ZK-AAN, G-UAAK*
233–235	*G-EBXX–'XZ*

*Air Associates Avian Special with 100 h.p. Wright Gipsy to ATC2–207 dated 1.5.30, A.U.W. 1,450 lb.
**Armstrong Siddeley Genet II.

(*h*) Production Avro 594 Avian IV

Constructor's Numbers	Aircraft markings
172, 182, 183	*G-AAAT, 'DL*, 'BX*
190–191	Air Associates *NC540E, PP-TCB*
194–197	Air Associates *NC502E, '03E, NC541E, '49E*
201–227	*G-AUKD, 'JZ,* Argentine, *G-AADF, G-AUKR,* Argentine, China (13), *X-CRIA, CF-CAQ**, 'AR**, G-AAEC,* Argentine, *G-UAAV, M-W111,* Aero Club of Yucatan (Mexico)
232, 236, 237	*G-AAGR, 'CE, 'CF*
242–247	Air Associates *NC550E, NC600E–'03E†, NC648E*
248–281	Whittlesey Body Co. *NC649E, '71E–'73E, NC11048, NC674E–'76E, NC818E–'21E, NC833E–'35E, NC221H, NC836E, NC222H–'24H, NC321H, NC632E, NC524K, '25K, NC710K, '11K, NC550K–'53K, NC712K, '13K, NC577K, NC737K*
303–304	*ZS-AAG, G-AAGP*
317–320	*G-AAHK***, 'HD, 'HE, 'HN*
323	*N-38/LN-ABF*
325–328	*G-AAIJ/M-CIAA, 'IK/M-CAIA, VH-UMW, 'RM*
330	*G-AAIX*

*Genet II, later Cirrus III. **Genet II. ***Later Gipsy I.
†Avian Special with 95 h.p. Menasco B-4 to ATC2-307 dated 29.11.30, A.U.W.1 ,525 lb.





The Avro 604 Antelope.

Avro 604 Antelope

Construction of the Antelope two seat, high performance day bomber was preceded by an elaborate wood and canvas mock-up erected at Hamble early in 1928 which rivalled even Broadsmith's Avro 590 mock-up for realism. The Antelope itself, flown at Hamble in November that year, was built to Air Ministry Specification 12/26 and fitted with a 480 h.p. Rolls-Royce F.XIB eight cylinder, watercooled Vee-type engine for selective competition with the Hawker Hart and Fairey Fox II. Issued in May 1926 the Specification called for a seemingly impossible top speed (for those days) of 160 m.p.h.

Intensive evaluation began at Martlesham on September 13, 1928 but though the Antelope and Fox II were among the most advanced two seat military biplanes of their day, only the Hart was ordered into production.

The Antelope was a single bay biplane with Frise-type ailerons on the upper wing only, and short span, narrow chord lower mainplane. The staggered, fabric covered metal wings were slightly swept back and the centre section struts formed an inverted Vee. The wing roots of the upper wing tapered to a very thin section at the point of attachment to ensure maximum forward view for the pilot, and aft of his seat was the gunner's cockpit with a single Lewis gun on a patent wind-balanced, small diameter Avro gun ring. Additional armament consisted of a fixed, forward firing Vickers gun and bombs on racks under the lower wing aimed by the gunner from a prone position in the fuselage bottom. The fuselage itself was a rigid structure built of duralumin sheeting riveted to a framework of L section dural strip, but strut and root end fittings were of stainless steel while the engine mounting and variable incidence tailplane were of welded steel tubing.

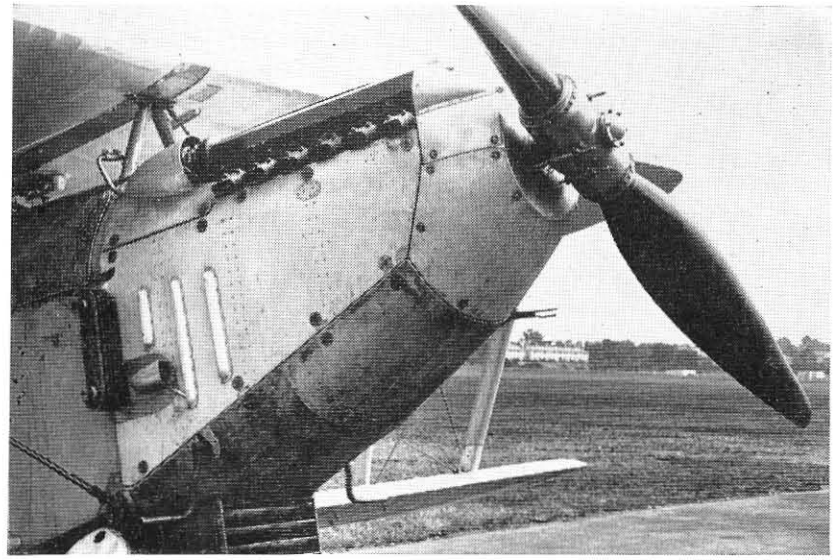
The engine drove a two bladed Fairey F.R.608 fixed pitch metal airscrew and was cooled by a chin-type radiator with controllable shutters. Sixty-five gallon main and 25 gallon gravity fuel tanks were housed in the fuselage behind the engine bulkhead, and the low drag undercarriage was of the long travel, oleo and rubber-in-compression type.

The Antelope was exhibited at the Olympia Aero Show, London, July 16–27, 1929 and despite its failure to secure a production contract, went to No. 100 Squadron, Bicester, for Service trials. It returned to Hamble in July 1930 for dual control to be fitted, afterwards ending its days at the R.A.E., Farnborough, as test bed for the early Gloster-Hele-Shaw-Beacham variable pitch airscrews. For this purpose it was twice re-engined, first with a 525 h.p. Rolls-Royce Kestrel IB and later with a 477 h.p. supercharged Kestrel IIS, but for greater airscrew efficiency the radiator was repositioned under the rear of the engine bay.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants: One 480 h.p. Rolls-Royce F.XIB
One 525 h.p. Rolls-Royce Kestrel IB
One 477 h.p. Rolls-Royce Kestrel IIS



The Antelope with Rolls-Royce Kestrel engine, Gloster-Hele-Shaw-Beacham variable pitch airscrew and repositioned radiator.

Dimensions: Span (upper) 36 ft. 0 in. (lower) 32 ft. 0 in.
Length 31 ft. 2 in. Height 10 ft. 9 in.
Wing area 377 sq. ft.

Weights: (Bomber, weighed 21.7.28)
Tare wt. 2,859 lb. All-up wt. 4,538 lb.
(Trainer, weighed 19.7.30)
Tare wt. 2,898 lb. All-up wt. 4,550 lb.

Performance with Rolls-Royce F.XIB (throttle-gated to 3,000 ft.):
Maximum speed 173 m.p.h. Cruising speed 145 m.p.h.
Initial climb 1,470 ft./min. Ceiling 22,000 ft.
Range 580 miles

Production: One prototype only, *J9183*, to Contract 762628/27



The Avro 611 (Cierva C.8L Mk. I) *J8930* with rudder from the earlier Avro 574 (Cierva C.6C). (*P. T. Capon Photo.*)

Avro 611 and 617 (Cierva C.8L)

Experimental autogiro flying already described was the beginning of a long association between the Cierva Autogiro Co. Ltd. (formed on March 24, 1926) and A. V. Roe and Co. Ltd. who built the machines at Hamble. Promising results with the C.6s and C.8s (vide Avro 574 etc.), led to Air Ministry Contract 698109/26 for a further prototype based on the Lynx engined Avro 504N. This was fitted with a rotor having four paddle-type, fabric covered, blades of 3 ft. mean chord, built from tubular steel spars with spruce ribs, and running on four ball races. Fuel, carried under the top wing of the 504N, was perforce transferred to a 24 gallon fuselage tank with gravity feed. On this and three subsequent machines of the type, rotor spinning prior to take-off was either by a rope wound round the hub, or by fast taxying.

Known as the Avro 611 (Cierva C.8L Mk. I), the new machine comprised a 504N-type fuselage with standard tail unit and engine installation but the elevator was horn balanced and a pylon comprising four steel tubes was mounted over the front cockpit. The undercarriage was the usual unbreakable N-type, widened and equipped with long travel, oleo and rubber-in-compression shock legs attached to the top instead of the bottom longerons. Lateral control was by ailerons hinged to a tubular steel boom.

First flown at Hamble by H. J. Hinkler in 1927, it bore R.A.F. roundels and serial *J8930*, but has spread confusion among historians ever since because it used the rudder of the crashed Avro 574/Cierva C.6C from which the number *J8068* had not been obliterated. Cierva, who had just qualified as a pilot with the Hampshire Aeroplane Club at Hamble on Avro Avians,

converted to rotary wing machines under the tutelage of Hinkler. Thenceforward he took an ever increasing part in autogiro development flying so that on September 30, 1927 it was the designer himself who delivered the Cierva C.8L Mk. I from Hamble to Farnborough, making the first cross country flight by a rotary winged aircraft in the U.K. in the process. Flight tests commenced at Farnborough with a C.8V-type rotor having blades of only 1 ft. 9 in. mean chord. This proved unsuccessful and *J8930* flew again with the original rotor on January 11, 1928. It remained at Farnborough until April 1930 and was written off at Andover about two months later.

A civil equivalent, the C.8L Mk. II (Avro 617) *G-EBYY*, was built in 1928 to the order of Air Commodore J. G. Weir, chairman of the Cierva Company, without whose financial backing most of the development work would have been impossible. The civil machine was similar to the first but part of the flying load was taken by a short span, thick section, fixed wing carrying the ailerons. The wide track undercarriage used the same long travel shock absorbers but was attached to the front spar of the auxiliary wing and each half of the axle was hinged to a 504K-type skid. Rotor bracing differed in detail from that of the Mk. I and the engine, this time a Lynx IV, was more closely cowled. Dual control, tail trim and rotor lateral control gears were also fitted.

The C.8L Mk. II was flown for the first time by Hinkler at Hamble early in May 1928 but Cierva damaged it at the Hamble Air Pageant on the 28th of that month. With the original unbalanced rudder and dorsal fin removed in favour of a standard comma-type balanced rudder, it faced the starter in the King's Cup Race at Hendon on July 20, flown by the newly appointed Cierva test pilot A. H. Rawson who was forced to retire from the race after landing at Caldecote, near Nuneaton, through fuel shortage. On August 7 Rawson began a 3,000 mile tour of the principal British civil and Service aerodromes and visited the grounds of the owner's estate at Dalrymple, near Turnhouse.

Then on September 18 *G-EBYY* became the first rotating wing aircraft to cross the Channel when Cierva, with the editor of the French aviation journal *L'Aéronautique* as passenger, flew the machine from Croydon to Le Bourget. After demonstrations Cierva picked up Rawson and left for Berlin via Brussels on October 3. Rawson returned with another passenger via Amsterdam on October 13 and brought the total mileage for the tour to 1,450. Although it retained British markings, *G-EBYY* returned no more to its native land and is believed to have spent some time with Weymann-Lepère who later built the more advanced C.18 autogiro. The C.8L Mk. II has remained ever since in the Musée de l'Air at Chalais Meudon near Paris, except for a brief period on exhibition at the Brussels Aero Show in 1950.

Publicity deriving from these exploits resulted in two overseas orders, the first being the Lynx IV powered C.8L Mk. III built for the Italian Government and test flown by A. H. Rawson in September 1928. The Mk. IV (or C.8W), a single machine built for the U.S.A. and flown at Hamble in November



The civil Avro 617 (Cierva C.8L Mk. II).

1928, was fitted with a 225 h.p. Wright Whirlwind J-5 for aircraft manufacturer Harold F. Pitcairn who had visited Hamble earlier in 1928, bought the American rights, and established the Pitcairn-Cierva Autogiro Co. Inc. at Bryn Athyn, Pennsylvania. The C.8L Mk. IV was shipped to the U.S.A. in December 1928, made the first autogiro flight in the U.S.A. when Pitcairn demonstrated it at Pitcairn Field, Willow Grove, Penn. in January 1929, and the first cross country flight in the U.S.A. from Pitcairn Field to Langley Field, Virginia, in the following May. At the end of its active life in 1931 the C.8L Mk. IV was presented to the Smithsonian Institute, Washington, where it was still in storage in 1963.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Rotor design: The Cierva Autogiro Co. Ltd., Bush House, Aldwych, London W.C.2

Power Plants: (C.8L Mk. I) One 180 h.p. Armstrong Siddeley Lynx
(C.8L Mks. II and III) One 180 h.p. Armstrong Siddeley Lynx IV
(C.8L Mk. IV) One 225 h.p. Wright Whirlwind J-5

Dimensions: (All marks) Rotor diameter 39 ft. 8 in.
Length 36 ft. 0 in. Height 14 ft. 9 in.

Weights: (C.8L Mk. I) All up weight 3,535 lb.
(C.8L Mk. II) Tare weight 1,650 lb. All-up weight 2,470 lb.

Performance: (C.8L Mk. I)
Maximum speed 68 m.p.h. Initial climb 110 ft./min.
(C.8L Mk. II)
Maximum speed 100 m.p.h. Cruising speed 85 m.p.h.
Initial climb 500 ft./min. Range 255 miles
(C.8L Mk. III)
Maximum speed 106 m.p.h. Initial climb 750 ft./min.

Production:	One aircraft of each mark.
C.8L Mk. I	*J8930*, first flown mid 1927, to the R.A.E. 30.9.27, written off at Andover about 6.30
C.8L Mk. II	*G-EBYY*, first flown 5.28, registered 21.6.28 to J. G. Weir, no c/n or C. of A., sold in France 4.30, preserved at the Musée de l'Air, Paris
C.8L Mk. III	For the Italian Government, first flown 9.28
C.8L Mk. IV	First flown 1.29, sold in the U.S.A. to H. Pitcairn, as *NC418*, preserved in the Smithsonian Institute, Washington from 1931



The Avro 612 (Cierva C.17) built from Avian IIIA components with 90 h.p. A.D.C. Cirrus III.

Avro 612 (Cierva C.17)

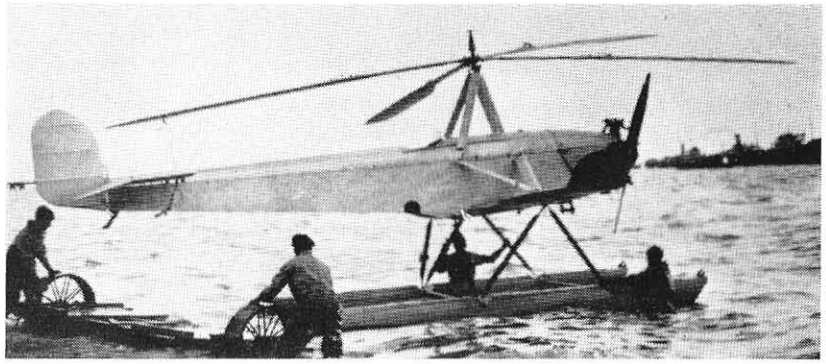
Encouraging results with the Cierva C.8L Mk. II prompted the construction at Hamble of a smaller version for private owners or flying clubs. Based on the Avro Avian IIIA with 90 h.p. A.D.C. Cirrus III engine and known as the Cierva C.17, the new autogiro used a similar rotor system to its predecessor, the wire braced paddle blades with flapping and drag hinges having proved the most satisfactory arrangement up to that time. The rotor was mounted on a tripod of faired steel tubes and was started in the usual way either by rope spinning or fast taxying. A fixed monoplane wing carrying full span unbalanced ailerons was braced to the top longeron by Vee struts and formed an anchorage for a wide track undercarriage comprising two Avian IIIA half units. A standard Avian tailplane was used but the fin and rudder were severely truncated to give adequate rotor clearance.

Internally the machine resembled any other Avian IIIA with the addition of a Vickers hand pump for transferring fuel from the main to gravity tank, and a rotor revolution counter.

The Avro 612/Cierva C.17 was first flown by Juan de la Cierva on October 23, 1928 but proved to be underpowered and was subsequently dismantled at Hamble where the major components were still in evidence in 1934. A second example, the Cierva C.17 Mk. II, with the slightly more powerful 100 h.p. Avro Alpha radial engine, was constructed early in 1929 but proved no more successful than the first. A further example then appeared as test vehicle for Cierva's C.12 rotor system, similar to the C.17 Mk. II but with blades of parallel chord. The pylon was initially a forward leaning wide chord strut, which later gave way to a pyramid of narrow steel tubes. An unbalanced rudder was used without fin and the tips of the fixed wing were turned up at a considerable dihedral angle. This feature in conjunction with the parallel

chord blades establish the C.12 as the link between the C.17 and later designs, despite the apparent inversion of numerical sequence.

Cierva first flew the C.12 at Hamble during 1929 and from Southampton Water on April 25, 1930 after it had been converted to single seater and mounted on Avian metal floats. In this form as the Hydrogiro, it was the first rotary winged seaplane. As detailed in another chapter, an Alpha engined autogiro was reconstructed at Hamble in 1935 as the Avro 594 Avian II *G-ADEO*. This was clearly the former C.17 Mk. II *G-AAGJ* but no records survive to identify the C.12 as an intermediate modification of this machine, although this was almost certainly the case.



The Avian-derived Alpha engined C.12 Hydrogiro ready for flight at Hamble on April 25, 1930.

SPECIFICATION AND DATA

Manufacturers:	A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Rotor design:	The Cierva Autogiro Co. Ltd., Bush House, Aldwych, London W.C.2
Power Plants:	(C.17 Mk. I) One 90 h.p. A.D.C. Cirrus III (C.17 Mk. II) One 100 h.p. Avro Alpha (C.12) One 100 h.p. Avro Alpha
**Dimensions:*	Rotor diameter 33 ft. 3¼ in. Length 28 ft. 9 in. Height 11 ft. 1 in.
**Weights:*	Tare weight 1,010 lb. All-up weight 1,455 lb.
**Performance:*	Maximum speed 90 m.p.h. Cruising speed 70 m.p.h. Initial climb 500 ft./min. Range 210 miles Rotor speed 130 r.p.m.

*C.17 Mk. I.

Production:	One aircraft only of each type
C.17 Mk. I	*G-AABP*, no c/n recorded, first flown 23.10.28, dismantled at Hamble 12.31
C.17 Mk. II	*G-AAGJ*, c/n 5129, registered 19.4.29, converted to Avian II *G-ADEO* in 1935
C.12	Possibly a modification of the C.17 Mk. II, unregistered, first flown 1929, first flown as Hydrogiro 25.4.30



Avro 616 Avian IVM *VR-HAA*, c/n 361, at Hong Kong in 1930. The metal fuselage can be recognised by the prominent stringers.

Avro 616 Avian IVM

A strengthened Avian IV with welded steel tube fuselage, produced in 1929 to meet overseas requirements, was designated Avro 616 Avian IVM. The redesign used the same type of fuselage construction as the Avro Tens and Fives at that time going through the Manchester works. This consisted of welded circular section longerons and struts, with diagonal strut bracing in the side panels and wire bracing top and bottom. The sides were then rounded out with fabric over wooden stringers and the top with a curved plywood decking. For a weight penalty of some 114 lb. an extremely robust structure was obtained, more easily inspected internally or repaired than the wooden version, and far more suitable for operation in remote areas.

Martlesham trials of the first Avian IVM *G-AACV* (90 h.p. A.D.C. Cirrus III), commenced on March 23, 1929, showed it to be light on the controls, easy to fly and to have good aerobatic qualities. The Cirrus was not quite powerful enough and early production Avian IVMs had either the 105 h.p. A.D.C. Cirrus Hermes I or an Armstrong Siddeley Genet Major five cylinder radial of 100 h.p. They also had variable incidence tailplanes.

One Avian IVM *J9783* was supplied to the Air Ministry under Contract 924141/29 for comparative trials with the Hawker Tomtit.

Large batches of Genet Major Avians IVMs were despatched to Canada in 1929–30 for erection by the Ottawa Car Manufacturing Co. Ltd. who later obtained Canadian manufacturing rights and built 18 for the Royal Canadian Air Force with 135 h.p. seven cylinder Genet Major Is and Goodyear airwheels. Most of the imported Avian IVMs were used by flying clubs, private owners and one-man 'outback' transport concerns, often on skis or floats but ten were used for R.C.A.F. initial training at Camp Borden. The Whittlesey Manufacturing Co., importers of Avian IIIs into the U.S.A., reached agreement with A. V. Roe and Co. Ltd. on December 24, 1928 for the manufacture



Manchester-built Avian IVM seaplane *CF-AHV*, c/n 299, with 100 h.p. Armstrong Siddeley Genet Major five cylinder radial on the Ottawa River 1931.

of the Avian IVM (Cirrus III) under licence and tooled up for the production of 2,000 machines a year. Their name was changed to the Whittlesey Body Co. on April 18, 1929 and A.T.C. Memo 2–176 (equivalent to a Special Category C. of A.) was issued to the Whittlesey Avian IVM on January 31, 1930 but only about ten were built before receivers were appointed in the following December.

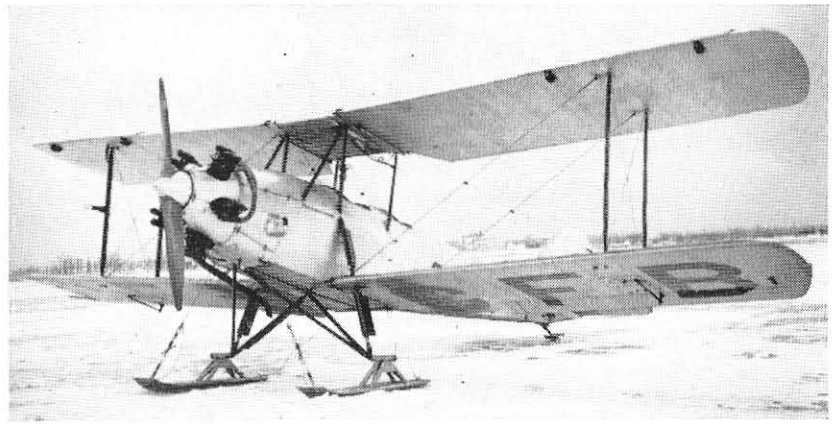
Other exports were handled by Mina S.A. in Mexico; Malayan Motors Ltd., Singapore; Ferrand and Rayson in Buenos Aires; and the Holmes Motor Co. Ltd. in Cape Town. A batch of six Genet Major Avian IVMs were based at Tallinn by the Estonian Air Force in 1929, the year in which the South African Air Force placed a contract for 20 similar machines for basic training. Ten of these were eventually disposed of to clubs and private owners as *ZS-AGK* to *'GP* and *'GR* to *'GU*, five of which (*'GK* to *'GN* and *'GS*) were impressed with new serials *2029–2033* during the Second World War.

Henlys (1928) Ltd. of Heston handled Avian IVM sales in the United Kingdom (demonstrator *G-AATL* Hermes I), and soon popularised them among private owners and sold several to the Liverpool, Lancashire and other major flying clubs. Air Service Training Ltd. used *G-ABKA*, *'KB*, *'SC* and *'UN* for instructional purposes at Hamble but *'KA* was destroyed when its wing tip flares set fire to long grass during a night landing on June 11, 1932. The second machine *'KB* acquired floats each summer for seaplane training on Southampton Water. These machines were the first of a small number fitted with the 135 h.p. seven cylinder Genet Major I, which included A. J. A. Wallace Barr's *G-ABME*, which, in the hands of F/Lt. E. A. Healy, averaged 122·5 m.p.h. in the 1931 King's Cup Race and 130·75 in the 1932 event. It was fitted later with a close fitting long chord NACA cowling.

Despite these activities, the Avian IVM's chief role lay overseas, as in Australia (where *VH-UOE* was acquired by Charles Ulm), in New Zealand, Kenya, and in Egypt where the Shell Company kept Genet Major engined *G-AATV*. This was the first of four metal Avians used by petrol companies

for sales promotion, the others being the British Petroleum Co.'s *G-ABIB* "Peri" flown by J. C. C. Taylor and the Anglo American Oil Co.'s *G-ABDN* and *'IE*. In common with many late production Avians, they were powered by 115 h.p. Cirrus Hermes IIs and boasted Handley Page slots. *G-ABIE* "High Test" also had an extra 110 gallon fuselage tank for Tommy Rose's attempt on the England–Cape record which started at Lympne at dawn on February 11, 1931. He was eventually forced to land 30 miles south of Luxor with sand in the engine during the return journey in the following May.

G-ABIC/*VR-TAD* "Tanganyika", fitted with tropical filters and Vickers-Potts oil cooler, joined its wooden brethren on the vast job of mapping the territory, and *SE-ACP* (Hermes II) was flown out to Gothenburg Aero Club



Canadian-built Genet Major Avian IVM *CF-CFB*, c/n 65258, on skis. (*B. van Sickle Photo.*)



Avian IVM *133* built in Canada by the Ottawa Car Manufacturing Co. Ltd. for the R.C.A.F. with seven cylinder 135 h.p. Genet Major I and Goodyear Airwheels.



H. F. 'Jim' Broadbent flying the record breaking Sports Avian *VH-UQE* "Dabs" near Melbourne in 1931.

by famous Swedish pilot Gosta Andree, in June 1931, but China was the largest single customer for the Hermes model. Large numbers were shipped via the Far East Aviation Co. Ltd. 1930–33, including one land machine and one seaplane for the Hong Kong Flying Club while others bore Hong Kong registrations for training Defence Force pilots at Kai Tak or onward ferrying to the Kwangtung Government flying school at Canton, or the Kwangsi Air Force at Luichow. A small number were single seaters with a compartment for 43 lb. of mail in place of the front cockpit. Their fuel capacity was raised to 35 gallons and the 'prototype', *VR-HAC* (Hermes I), completed Martlesham trials in August 1930.

To cater for sporting owners wanting 'better than standard' performance, a Hermes I version known as the Sports Avian appeared in 1930 with straight axle undercarriage, cut-away top decking and racing windscreens. It also had the top centre section gap filled by a flap, hinged to give easy access to the rear cockpit. Flown by F/Lt. J. Oliver and J. C. Cantrill, the first two Sports Avians *G-AAWI* and *'YU* took part in the King's Cup Race at Hanworth on July 5, 1930 but both forced landed in Gloucestershire due to bad weather.

Sports Avian *VH-UQE* "Dabs" (Gipsy II), despatched to Australian National Airways in June 1931, was the machine in which H. F. 'Jim' Broadbent made a record one-day solo flight round four States on August 12, 1931 and completed a record 7,600 mile round-Australia flight of 7 days 8 hours 15 minutes on September 6. It was still flying in Australia 30 years later. *G-AAXH*, another of the type, was test flown by R. L. Palmer at Hanworth in 1936 with an experimental reversed tricycle undercarriage designed by British Landing Gears Ltd. and built by the Rollason Aircraft Co. Ltd. This device allowed the Avian to be flown on to the ground with no 'hold off' at speeds considerably in excess of the stall.

R. H. Dobson's 1930 King's Cup entry, *G-AABS*, was a standard Genet Major Avian IVM fitted with a Sports Avian undercarriage in which D. S. Green averaged 106·4 m.p.h. round Britain and came fifth. This machine was one of three trial installation IVMs *G-AABR*, *'BS* and *'BT*, the first of which was used in 1930 for experiments with a closely cowled Genet Major. After the 1930 King's Cup Race, *'BS* was flown with Class B marking *K-2* to test special 30 ft. span wings without centre section gap destined for the long range, single seat Avian IVA "Southern Cross Junior" *G-ABCF* which Sir Charles Kingsford Smith had ordered for his attempt to lower Hinkler's England–Australia record. With the 120 h.p. de Havilland Gipsy II the Avian IVA had a still air range of 1,860 miles at 92 m.p.h. cruising speed, achieved by supplementing the 24 gallon centre section tank with a welded aluminium tank holding 91 gallons in a specially strengthened fuselage. With such a machine the attempt could hardly fail, and 'Smithy' left Heston at dawn on October 9, 1930. He reached Darwin in triumph 9 days 21 hours later but soon disposed of the machine to Guy Menzies who used it for the first solo southbound crossing of the Tasman Sea to New Zealand. He landed upside down in a swamp at Hari Hari near Hokitika at the completion of a 10 hour 15 minute, 1,235 mile flight on January 7, 1931. After repair at Wigram, *'CF* was shipped back to Sydney where L. Palmer and A. James were killed when it crashed on April 12, without the allotted Australian marks *VH-UPT* being taken up.

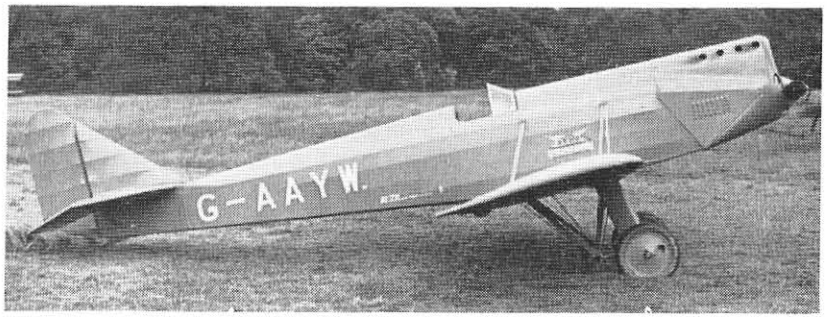
A second long range single seater, *VH-UQG* "Southern Cross Minor", built for Kingsford Smith later in 1931, was known as the Avian V. It differed considerably from the first because the fuselage was that of a standard, instead of a Sports model, Avian IVM and the wings were of standard 28 ft.



Avian IVM *G-AAXH*, c/n 456, at Hanworth in 1936 with B.L.G. reversed tricycle undercarriage. *(E. J. Riding Photo.)*



G-AAYV, the first Avro 625 Avian Monoplane, with Genet Major I radial.



G-AAYW, the second Avian Monoplane, with Cirrus Hermes I. (*'Flight' Photo 8865.*)

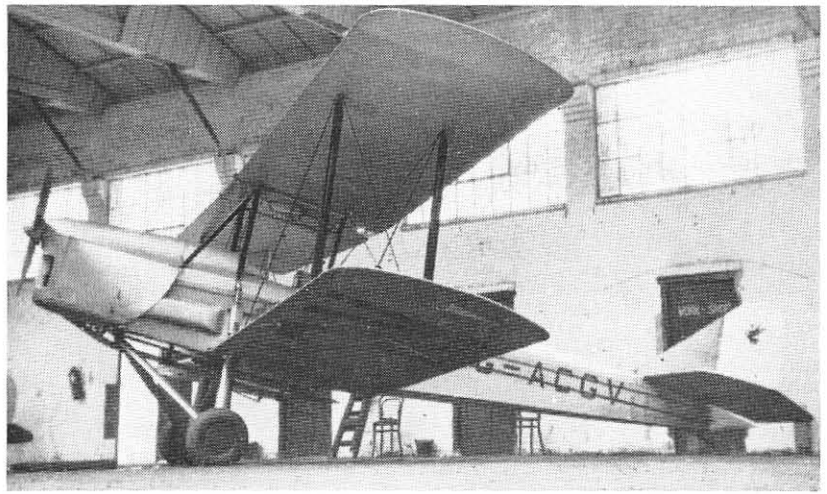


Kingsford Smith's famous long range Avian IVA "Southern Cross Junior" *G-ABCF.*

span, but the engine was again a Gipsy II. He left Melbourne on September 21, 1931 to attempt a record trip to England but was compelled to give up in Turkey through illness. W. N. Lancaster, former pilot of the Avian III "Red Rose", then acquired "Southern Cross Minor", re-registered as *G-ABLK*, for an attempt on the England–Cape Town record. He left Lympne at dawn on April 11, 1933 and landed at In Salah on the trans-Saharan motor track next day, after which he disappeared and it was not until 29 years later, in March 1962, that a French desert patrol found his mummified body and the wreck of the Avian V some 170 miles south of Reggane.

Competing against the Sports Avian in the 1930 King's Cup Race were two special Avro 625 wire braced, single seat, low wing racing monoplanes using Sports Avian fuselages equipped with wide track N-type undercarriages, later faired to resemble the trousered type. The first Avian Monoplane *G-AAYV*, flown by F. Tomkins, was powered by a Genet Major and the other, *'YW*, by a Cirrus Hermes I. Handicapped out of the race, Tomkins retired but T. Neville Stack came 48th in *'YW* at an average speed of 119·7 m.p.h. The Genet Major model was then reconstructed as a standard biplane but *'YW* was acquired by Sqn. Ldr. R. L. R. Atcherley who fitted a 115 h.p. Hermes II and kept it at R.A.F. Market Drayton until A.T.A. Captain W. L. Handley bought it in June 1940 and flew it to Elmdon.

The last three Avians were produced in the summer of 1933 for the Merseyside Aero and Sports Co. Ltd., operators of the Liverpool Aero Club, Speke. Fitted with de Havilland engines for uniformity with the rest of the club fleet, they were a Sports Avian *G-ACGV* with Avian IVM undercarriage (120 h.p. Gipsy III) and two standard Avian IVMs *G-ACIF* (100 h.p. Gipsy



The Liverpool Aero Club's unique D. H. Gipsy III powered Sports Avian *G-ACGV*, c/n 649. (*E. J. Riding Photo.*)

I) and *G-ACKE* (120 h.p. Gipsy II). The last had been built for Australian National Airways in February 1930 as *VH-UOB* but was re-engined and registered in the U.K. for the first time in September 1933.

Only four metal Avians were impressed by the R.A.F. in 1940. All became instructional airframes and included the ex-Liverpool *G-ACGV*, presented to the R.A.F. by owner Dr. J. W. A. Hunter, and *G-ACNK* (Genet Major) which originated in South Africa and spent the major portion of its British registered life with R.A.F. officers serving in the Near East.

Several machines survived the war, including Sports Avians *VH-UQE* and *ZK-ACM* (still flying in Australia and New Zealand respectively in 1963), and the Gipsy II Avian IVM *G-ACKE* which Mr. Percy Blamire had carefully preserved at Queens Road Garage, Coventry. Overhauled at Walsall in 1948, it passed eventually to H. M. Woodhams at Baginton where it was seriously damaged when struck by a Tiger Moth on July 26, 1950. The late H. R. A. Edwards' Sports Avian *G-ABEE* also flew at Bassingbourn in 1948 but was in poor condition and eventually donated its fuselage to *'KE*.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester
The Ottawa Car Manufacturing Co. Ltd., Ottawa, Canada
The Whittlesey Body Co. Inc., Bridgeport, Connecticut, U.S.A.

Power Plants: One 90 h.p. A.D.C. Cirrus III
One 100 h.p de Havilland Gipsy I
One 100 h.p. Armstrong Siddeley Genet Major (5 cylinder)
One 105 h.p. A.D.C. Cirrus Hermes I
One 115 h.p. A.D.C. Cirrus Hermes II
One 120 h.p. de Havilland Gipsy II
One 120 h.p. de Havilland Gipsy III
One 135 h.p. Armstrong Siddeley Genet Major I (7 cylinder)

Dimensions:

Span (Avian IVA) 28 ft. 0 in	(Avro 625) 30 ft. 0 in.	
Length 24 ft. 3 in.	(seaplane) 25 ft. 0 in.	
Height 8 ft. 6 in.	(seaplane) 9 ft. 6 in.	
Wing area 245 sq. ft.	(Avian IVA) 262 sq. ft.	

Weights and Performances:

	Avian IVM	Avian IVA	Sports Avian	Avro 625
Tare weight	1,000 lb.*	1,100 lb.	1,005 lb.	942 lb.††
All-up weight	1,600 lb.**	2,225 lb.	1,600 lb.	1,351 lb.††
Maximum speed	100 m.p.h.†	115 m.p.h.	120 m.p.h.	—
Cruising speed	90 m.p.h.	92 m.p.h.	105 m.p.h.	—
Initial climb	600 ft./min.	485 ft./min.	—	1,000 ft./min.
Ceiling	12,500 ft.	12,500 ft.	—	—
Range	360 miles	1,860 miles	420 miles	—

*Prototype (Cirrus III) 1,049 lb.; Gipsy I 988 lb.; single seat mailplane 1,100 lb.; seaplane (Genet Major I) 1,353 lb.

**Mailplane 1,610 lb.; Whittlesey Avian IVM (Cirrus III) 1,579 lb.; seaplane (Genet Major I) 1,850 lb.

†Hermes II and Genet Major I 115 m.p.h.; seaplanes with these engines 109 m.p.h.

††With Genet Major.

Production:

(*a*) Avian IVMs by A. V. Roe and Co. Ltd.

Constructor's Numbers	Aircraft markings
239–240	*G-AACV*, Mexico
282–302	Canada (2), *CF-CAZ*, *'AY*, Canada (2), *CF-AEZ*, *CF-CAJ*, Canada (3), *CF-CBA*, Canada (2), *CF-CDI*, *'DF*, *'BD*, *CF-AHV*, *CF-CBC*, *'BB*, *'BJ*
305–315	Mexico, Canada, *CF-CDG*, *'DU*, *'DH*, *'DE*, Canada, *CF-CDL*, *'DJ*, *'DQ*, *'DR*
324, 329, 332	*G-AAKA*, Mexico, *VT-ABD*
334–354	South African Air Force *504–523*, *G-AAWF*
361–368	*VR-HAA*, *'AB*, Estonia (6)
369, 385, 386	*VH-UMX*, *ZS-ABQ*, *ZK-ABJ*
372, 387	*VH-UOE*, airframe to Hamble
414–417	*VH-UOB*, *G-AATL*, *'VM*, *'VP*
418, 420, 422	*G-AAWH*, *G-ABCD*, *'CO*
425–434	*R.C.A.F. 92–101*
435, 438	*G-AATV*, *G-AAUN*/*VR-TAA*
443–452	Canada (10)
453	Airframe to Brooklands
465–466	*M-CEAA*, *VR-HAC*
469–472	China (3), *G-ABDP*
475, 479, 486	*VR-HAD*, *G-ACNK*, *G-ABIC*
489, 491, 494	*G-ABHL*, *'IE*, *VR-HAG*
495, 500, 503	*VR-HAH*, *G-ABIW*, *'KA*
404, 522, 529	*G-ABKB*, *'LF*, *'ME*
530, 532	*SE-ACP*, *G-ABMO*
533	Airframe to Avro, Hamble
534–535	China (2)
554–557	*VR-HAI*, *'AJ*, *'AL*, *'AK*
559–560	*VR-HAM*, *'AN*
562–568	*G-ABSC*, China (6)
577–579	*VR-HAO*, *'AP*, *'AS*
580, 587, 588	*VR-HAT*, *G-ABUN*, *'VL*
590–591	*VR-HBB*, *'BC*
598–605	*VR-HBJ*, *'BI*, *'BO*, *'BL*, *'BS*, *'BT*, *'BM*, *'BP*
608–619	*VR-HBV*, *'BW*, *'BY*, *'BU*, *'BR*, China, *VR-HCG*, *'CF*, *'CB*, *'CC*, China (2)
656	*G-ACIF*

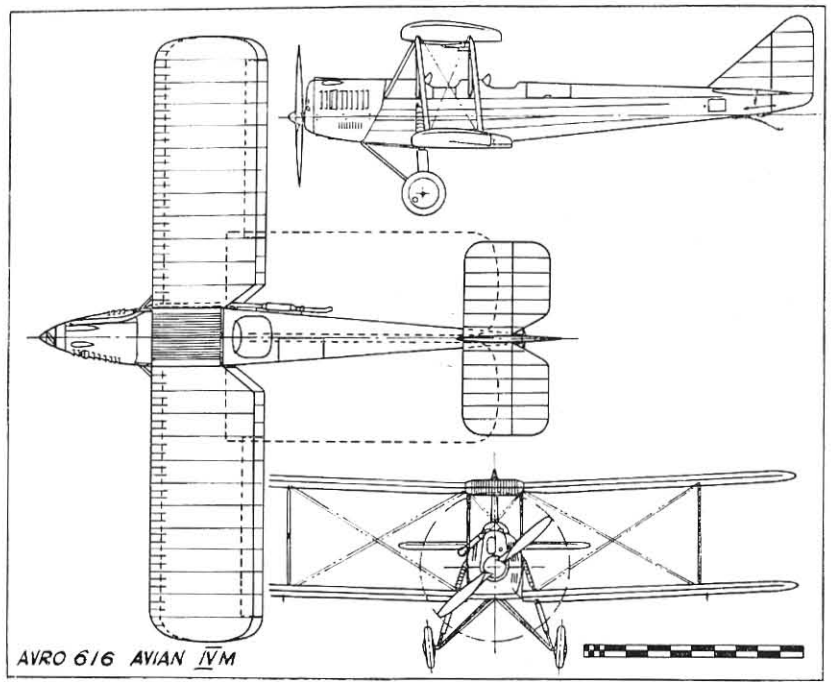
(*b*) By the Ottawa Car Manufacturing Co. Ltd.

Eighteen delivered to the R.C.A.F. (serials *125–138* and *141–144*), the majority of which were sold eventually for civil use as under.

Constructor's Numbers	Aircraft markings
65249–65259	*CF-CFC*, *'FH*, *'FI*, *'EW*, untraced (2), *CF-CEY*–*'FB*, *'EV*
316–321	*CF-CDV*, *'DT*, *'DW*, untraced (1), *CF-CDX*, *'DL*

(*c*) By the Whittlesey Body Co. Inc.

Constructor's Numbers	Aircraft markings
At least 100–106	*NC530M*, *NC199N*, *NC804N*–*NC806N*, *NC47V*, *NC48V*



(*d*) Sports Avians by A. V. Roe and Co. Ltd.

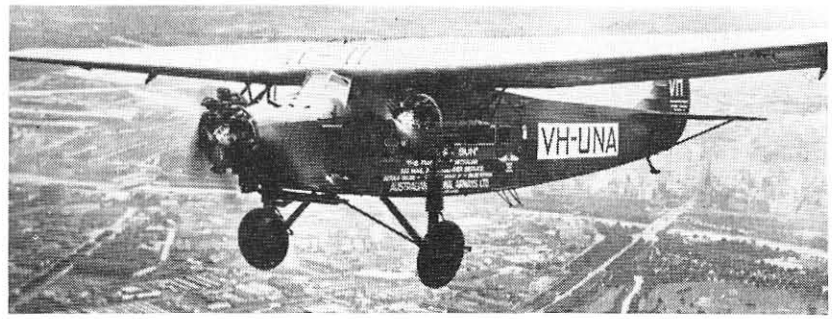
Constructor's Numbers	Aircraft markings
419, 421, 423	*G-AAYU, G-ABCE, 'DN*
424	*G-ABEA*
454–456	*G-AAWI*, Mexico, *G-AAXH*
473–474	*G-ABEE, 'ED*
490	*G-ABIB*
499, 501, 505	*ZK-ACM, G-ABIB, 'KI*
531, 576, 649	*VH-UQE, G-ABSS, G-ACGV*

(*e*) Avro 625 Avian Monoplanes

Constructor's No. and Registration		*C. of A. Issued*	*Details*
459	*G-AAYV*	27. 6.30	Genet Major I; converted to biplane 1931, to J. R. Ford, Broxbourne 5.38, scrapped 1939
460	*G-AAYW*	27. 6.30	Hermes I: to F/Lt. R. L. R. Atcherley 9.30, fitted Hermes II, W. L. Handley 6.40, scrapped during the war

(*f*) Long range aircraft for Sir Charles Kingsford Smith

Constructor's No. and Registration		*C. of A. Issued*	*Details*
467	*G-ABCF*	26. 9.30	Avian IVA; Australia Flight 10.30, Tasman Flight 1.31, allotted *VH-UPT*, crashed at Mascot 12.4.31
523	*G-ABLK*	21. 7.31	Avian V "Southern Cross Minor"; abortive Australia–U.K. Flight 9.31 as *VH-UQG*, to W. N. Lancaster 4.33 restored as *G-ABLK*, lost in the Sahara 13.4.33, wreck discovered 3.62



Avro 618 Ten *VH-UNA* "Southern Sun" leaving Sydney for Croydon with the Christmas mail on November 16, 1931.

Avro 618 Ten and Variants

In 1928 R. H. Dobson, H. E. Broadsmith and other Avro key personnel spent some time in the works of N. V. Nederlandsche Vliegtuigenfabrik (Fokker), Amsterdam, examining drawings, design data and production processes and their favourable report led to the acquisition of a licence to build the Fokker F.VIIB/3m for sale throughout the British Empire (excluding Canada). Worldwide success of this rugged, three engined, high wing transport resulted from combining a one-piece, thick section, plywood covered cantilever wing with a welded steel tube, fabric covered fuselage. Paradoxically these were the very features distrusted by the British authorities. Fortunately the British Air Ministry was already in possession of a Netherlands-built F.VIIA/3m *J7986*, delivered in May 1926 by Fokker's chief test pilot Grasé, who had astonished spectators by looping it on arrival over Martlesham. A series of tests during which it defeated all attempts to break it eventually cleared the way for the certification of the Avro-built version. Although generally similar to the Dutch original, it differed slightly in detail to meet British airworthiness requirements, notably in the downward tilt to the thrust line of the nose engine. Powered by three 240 h.p. Armstrong Siddeley Lynx IVB radials, it was known as the Avro 618 Ten, so called because it carried eight passengers and two crew.

Total production amounted to 14 aircraft, including five for Australian National Airways Ltd. founded in 1929 by Sir Charles Kingsford Smith and Charles Ulm. The first of these was exhibited at the Olympia Aero Show, London, in July 1929 and later received British marks *G-AADM* for test flying at Woodford. By way of compliment to 'Smithy's' veteran Fokker flagship "Southern Cross", the new machines were named "Southern Sky, Star, Moon, Cloud and Sun" respectively for use on the daily, six hour, 500 mile Brisbane–Sydney service opened on January 1, 1930 and the daily 480 mile Sydney–Melbourne route inaugurated on June 1.

On April 29, 1931 "Southern Sun" (Capt. P. Lynch Blosse) and "Southern Star" (Capt. J. A. Mollison) helped distribute the first experimental England–Australia air mail by collecting the bags from Kingsford Smith and the "Southern Cross" at Brisbane and flying them to Sydney and Melbourne respectively. The same Avro Tens returned to Brisbane with the first northbound mail on April 23-24 and two others performed a similar function for the second service when "Southern Moon" (Capt. P. G. Taylor) left Darwin on May 14 for Sydney where "Southern Sky" (Capt. E. Chaseling) picked up the mail for Melbourne.

The cost of the search for "Southern Cloud" (Capt. W. T. Shortridge), which disappeared over the Strathbozie Mountains between Sydney and Melbourne on March 21, 1931, and a falling-off in traffic, forced A.N.A. to close down, the last major operation being the special 1931 Christmas mail flight which carried 52,780 packets weighing 1,340 lb. to England. "Southern Sun" (Capt. G. U. Allan) left Hobart, Tasmania, on November 15, picked up the Australian mail and left Darwin northbound on the 23rd, but the machine was severely damaged in a take-off accident at Alor Star on the 26th. By flying long forced stages in "Southern Star", Kingsford Smith saved the situation and landed the mail at Croydon on December 16. After an extremely rapid top overhaul by Avros at Hamble, the Avro Ten left again on January 1, 1932 and arrived at Darwin on the 19th.

On its return from Croydon "Southern Star" was sold to the Hart Aircraft Co. Ltd. which opened a twice weekly Melbourne–Flinders Island–Launceston service with it on April 4, 1933. But the mystery of the disappearance of "Southern Cloud" remained unsolved. It was not until 27 years later on October 26, 1958 that the wreck was located near the top of a 5,000 ft. mountain in the Toolong Range. A maker's plate inscribed 'Avro 10 No. 1' (confirming it as *VH-UMF* ex *G-AADM*) was still readable.

Avro Tens *VH-UNJ* and *'PI*, built for the Queensland Air Navigation Co. Ltd. of Brisbane, inaugurated a thrice weekly Townsville service on April 1, 1930 and the Lismore and Grafton routes on August 12. When the company closed down in January 1931, these and the former A.N.A. "Southern Sky" were taken over by New England Airways Ltd., the firm responsible for the Brisbane–Narromine sector of the first regular England–Australia air mail service, flown by "City of Grafton", formerly "Southern Sky" (Capt. K. Virtue) on December 21, 1934.

The slump which closed A.N.A. also brought the Hart Tasmania service to an end in February 1934, its single Avro Ten *VH-UMG* being transferred to Australian Transcontinental Airways Ltd. for a new Adelaide–Darwin service opened by Capt. J. Chapman on August 19, 1935. This venture was equally short lived and ceased on October 11 the same year. When New England Airways Ltd. also closed down, its small fleet of Tens was acquired by Airlines of Australia Ltd., Sydney.

A change of name also occurred when Charles Ulm bought the old "Southern Moon" from the liquidators of A.N.A. in 1932 and called in

Wing Cdr. L. J. (later Sir Laurence) Wackett who rebuilt it at Cockatoo Island Dockyard as a long range machine similar to "Southern Cross". The mainplane was lengthened and the airframe strengthened to take a series of 260 gallon fuel tanks, and the Lynx engines gave way to three 330 h.p. Wright Whirlwind J6–7 radials. Restyled *VH-UXX* "Faith in Australia", the machine was wheeled out on June 1, 1933, first flown on June 14 and left Sydney for a projected world flight on June 24 with Ulm, P. G. Taylor and G. U. Allan as crew. Engine trouble prevented them reaching England in record time and *'XX* did not land at Heston until 17 days later on July 10. Further bad luck at Portmarnock Strand, Dublin, where the undercarriage collapsed under the weight of fuel and the tide engulfed the machine on the eve of take-off for the Atlantic crossing, necessitated reconstruction by Avros at Woodford using an entirely new fuselage having standard passenger windows. "Faith in Australia" was then flown to Brooklands where Ulm decided to abandon the world flight. Instead he left the Fairey aerodrome at Heathrow on October 12 and successfully reduced the England–Australia record time to 6 days 17 hr. 45 min. by arriving at Derby W.A. at midnight on the 19th.

During the night of December 3–4 *VH-UXX* made her first passage of the Tasman Sea in the course of which two lady passengers were carried to New Plymouth. After a barnstorming tour of New Zealand Ulm made the returning crossing with mail on February 2, 1934 after which the aircraft made two more special return mail crossings (April 11/14, May 11/July 12) and later flew the first experimental air mail to New Guinea. After the loss of Ulm in the Pacific in an Airspeed Envoy in November 1934, *'XX* languished



Charles Ulm, P. G. Taylor and crew at Woodford in October 1933 with the rebuilt Avro Ten "Faith in Australia" (three 330 h.p. Wright Whirlwinds).

in its old hangar at Mascot until equipped with neon signs in 1935 for night advertising over Sydney. In 1941 Stephens Aviation Ltd. took it to Wau for goldfields work and in the early days of the Jap invasion it made many evacuation flights between New Guinea and Australia. Although it escaped the Japs this historic aeroplane was left to rot away behind a hangar at Townsville N.T.

In April 1931 the sixth Avro Ten, *G-AASP*, was delivered to Imperial Airways Ltd., named "Achilles" and despatched to Cairo on long term charter to the Iraq Petroleum Transport Co. Ltd. for the desert pipeline patrol. A second machine, *G-ABLU*, delivered in June 1931 and named "Apollo", also went to Iraq. Both Avro Tens returned to European charter work in June 1933, but were based occasionally at Le Bourget to operate the Zürich service. "Apollo" was burned out after striking a radio mast between Ghent and Bruges while flying the Brussels–Croydon service on December 30, 1938 but "Achilles" survived until the early part of the Second World War.

In an attempt to establish air routes in India, four Avro Tens were built in 1931 for Indian State Airways, but financial stringency led to the abandonment of the scheme and the order was cut back to a single aircraft, *VT-ACT*, for the use of the Viceroy. Two of the frustrated machines were sold immediately to the Egyptian Army Air Force and left Heston in British marks at dawn on January 11, 1932 piloted by Messrs. Clarkson and Cameron, but in September 1934 one at last found its way to the Karachi–Lahore service of Indian National Airways Ltd. The Viceregal Ten was used in 1937 to fly British Air Ministry officials over the Southern Shan States to survey a proposed air route to China. The fourth machine of the original Indian order remained in the Avro works until completed as *G-ACGF* in April 1933 to the order of John Sword to supplement Airspeed Ferries on the Renfrew–Belfast and Renfrew–Speke scheduled services of Midland and Scottish Air Ferries Ltd.

Last of all the Avro Tens was *K2682*, delivered to the Wireless and Equipment Flight at the R.A.E., Farnborough, on July 27, 1936.

Exhibited alongside the Avro Ten at Olympia in 1929 was a scaled down version designed entirely by Roy Chadwick and his team. Powered by three Armstrong Siddeley Genet Majors, it would maintain 5,500 ft. on two engines and because it accommodated pilot and four passengers, was known as the Avro 619 Five. After the show it was slightly modified for Wilson Airways Ltd., Nairobi, Kenya, as *VP-KAE* "Knight of the Grail" for use on local services. The long ferry flight from Heston was made in October 1929 by T. Campbell Black, and a second machine *VP-KAD* "Knight Errant" followed in February 1930.

A third Avro Five *VH-UNK* was shipped to Brisbane to join the Avro Tens of the Queensland Air Navigation Co. Ltd. and the fourth and final machine was the British demonstrator *G-AASO*. This was flown in the King's Cup Race of July 5, 1930 by F/Lt. S. L. G. Pope but was not really suitable for



Wilson Airways' Avro 619 Five *VP-KAE* with the original cockpit canopy.



Avro 624 Six prototype *G-AAYR* with flat windscreen and high mounted nacelles. (*'Flight' Photo 8874.*)

racing and retired at its home base, Woodford. Two months later *'SO* also flew to Kenya to replace the first Wilson machine and continued on the African services in British marks until it was damaged beyond repair in a forced landing 12 miles from Broken Hill while en route from Salisbury on January 18, 1932.

Projected single engined Avro Fives (Armstrong Siddeley Panther) as Avro 628 and 629 mailplanes were not proceeded with.

A slightly larger version with widened cockpit for two pilots side-by-side with dual control, increased cabin headroom, lavatory at the rear, and engine nacelles fitted directly to the underside of the mainplane, appeared in May 1930 as the Avro 624 Six. Registered *G-AAYR*, the Avro Six was subjected to exhaustive test flying at Woodford and Heston, as a result of which the outboard engines were refitted in underslung nacelles in the manner of the Avro Five. The flat cockpit windscreen was also replaced by a metal framed structure with angled panels to deflect the rain. Test flying in this condition took place at Woodford with Class B marking *K-5* superimposed on the



The third Avro Six *G-ABBY* remodelled for Air Service Training Ltd. in 1931 with underslung nacelles and angled windscreen. (*'The Aeroplane' Photo.*)

registration, and as a result of demonstrations at Heston later in 1931, the machine was sold with one other to the Far East Aviation Co. Ltd. for delivery to China. A third Avro Six *G-ABBY*, remodelled in 1933 as a hybrid Five/Six with underslung nacelles and angled windscreen as a navigators' flying classroom for Air Service Training Ltd., remained in service at Hamble until taken over by No. 11 Air Observers' Navigation School in the early days of the Second World War.

A further high wing development, not readily recognisable as a Fokker derivative, was the twin engined Avro 642/2m, known initially as the Avro Eighteen. This machine used the Avro Ten mainplane lowered to the shoulder position with two 460 h.p. Armstrong Siddeley Jaguar VID radial engines mounted on the leading edge. Aerodynamically it was a much cleaner design than the Ten, and when first built had a glazed semi-circular nose to the pilot's compartment but this was damaged in a gale and replaced by a conventional stepped windscreen. As indicated by the original designation, accommodation was for two crew and 16 passengers. The prototype, *G-ACFV*, delivered to Midland and Scottish Air Ferries Ltd. at Renfrew in April 1934, was followed by the only other machine of the type. This was *VT-AFM*, the Avro 642/4m variant powered by four Armstrong Siddeley Lynx IVC engines. Named "Star of India" and built to the order of the Indian Government to Air Ministry Specification C.11/30 as replacement for the Avro Ten *VT-ACT*, it was flown out by Nevill Vintcent to whom it was handed over at Croydon on December 9, 1934. The Avro 642/4m was a seven seater used as personal aircraft of the Viceroy, Lord Willingdon, and differed from *G-ACFV* in having a pilot's door on the port side of the front fuselage and full length clear view windows in place of portholes. It remained in service at Delhi for several years but was withdrawn after a vehicle damaged a wing tip in 1940 and revealed white ant activity inside the wing.

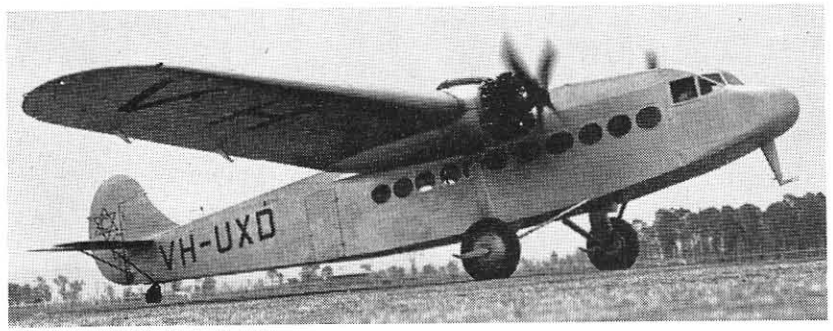
When Midland and Scottish Air Ferries Ltd. ceased operations, *G-ACFV* was sold to Commercial Air Hire Ltd. of Croydon and formed the mainstay of the early morning Continental newspaper delivery flights during 1935-36,

Later in 1936 W. R. Carpenter and Co. Ltd. bought it for mail services in New Guinea, where it continued in service with Mandated Airlines Ltd. until the Japanese destroyed it in 1942.

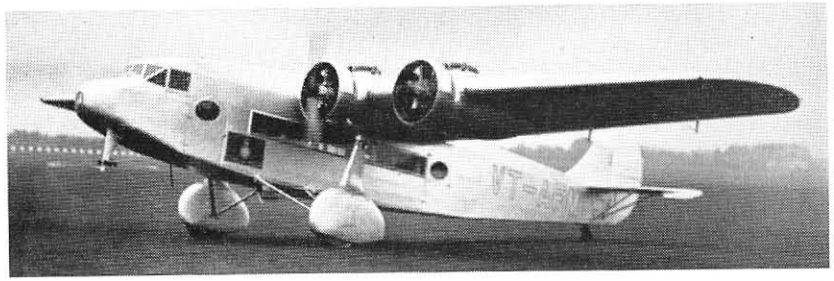
The military potential of the Avro 642 was not overlooked and type number Avro 655 was allotted to a projected bomber (two Jaguar VIA) with front and rear gunners. Preliminary layouts were made in November 1933 but the machine was not built.



The Avro 642/2m *G-ACFV* with original semicircular nose.



The Avro 642/2m *G-ACFV*/*VH-UXD* at Brisbane during its delivery flight to New Guinea in 1936.



The Viceroy's Avro 642/4m *VT-AFM* "Star of India" at Croydon, December 1934. (*'Flight' Photo 11097S.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.

Power Plants:

(Avro 618)	Three 240 h.p. Armstrong Siddeley Lynx IVB or IVC Three 330 h.p. Wright Whirlwind J6-7
(Avro 619)	Three 105 h.p. Armstrong Siddeley Genet Major
(Avro 624)	Three 105 h.p. Armstrong Siddeley Genet Major
(Avro 642/2m)	Two 450 h.p. Armstrong Siddeley Jaguar VID
(Avro 642/4m)	Four 240 h.p. Armstrong Siddeley Lynx IVC

Dimensions, Weights and Performances:

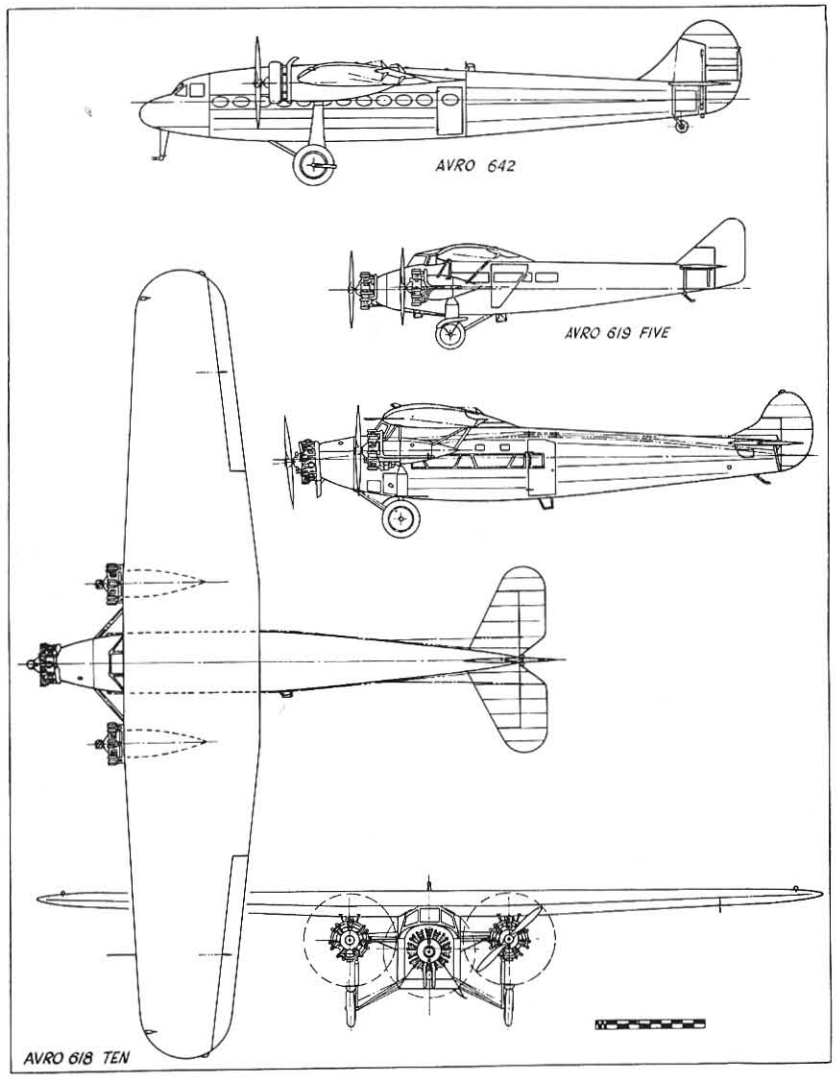
	Avro 618	Avro 619	Avro 624	Avro 642/2m	Avro 642/4m
Span	71 ft. 3 in.*	47 ft. 0 in.	51 ft. 0 in.	71 ft. 3 in.	71 ft. 3 in.
Length	47 ft. 6 in.	35 ft. 9 in.	36 ft. 0 in.	54 ft. 6 in.**	54 ft. 6 in.
Height	12 ft. 9 in.	9 ft. 6 in.	9 ft. 6 in.	11 ft. 6 in.	11 ft. 6 in.
Wing area	772 sq. ft.*	333 sq. ft.	360 sq. ft.	728 sq. ft.	728 sq. ft.
Tare weight	6,020 lb.***	3,062 lb.	3,058 lb.	7,360 lb.	8,731 lb.
All-up weight	10,600 lb.***	4,620 lb.	5,000 lb.	11,800 lb.	12,250 lb.
Maximum speed	115 m.p.h.	118 m.p.h.	113 m.p.h.	156 m.p.h.	150 m.p.h.
Cruising speed	100 m.p.h.	98 m.p.h.	95 m.p.h.	125 m.p.h.	130 m.p.h.
Initial climb	675 ft./min.	650 ft./min.	500 ft./min.	970 ft./min.	750 ft./min.
Ceiling	16,000 ft.	15,000 ft.	14,000 ft.	17,500 ft.	15,000 ft.
Range	400 miles	400 miles	400 miles	600 miles	560 miles

*"Faith in Australia."
**Original curved nose 53 ft. 0 in.
***K2682 5,743 lb. and 10,225 lb. respectively; "Faith in Australia" 16,000 lb.

Production:

(*a*) **Avro 618 Ten**

Fourteen aircraft as follows: c/n 229 *VH-UMH*, C. of A. 5.9.29, A.N.A. "Southern Sky", to New England Airways 8.33 as "City of Grafton", s.o.r. 1.36; 230 *VH-UMG*, 3.9.29, A.N.A. "Southern Star", to Hart 3.33, to A.T.A. 9.35, beyond repair Mascot 21.11.36; 231 *VH-UMI*, 10.10.29, A.N.A. "Southern Moon", rebuilt 2.33 as *VH-UXX* "Faith in Australia" c/n 1A, to Eastern Air Transport Ltd. 8.35, Kingsford Smith Air Service Ltd. 6.38, Stephens Aviation Ltd., in New Guinea 5.41, derelict at Townsville Q. 1942; 241 *G-AADM*, 26.8.29, to A.N.A. as *VH-UMF* "Southern Cloud", lost in the Strathbozie Mts. 21.3.31; 371 *VH-UNJ*, 27.11.29, Queensland Air Navigation Co. Ltd., to New England Airways 1.32 as "City of Brisbane", to Airlines of Australia Ltd., s.o.r. 6.40; 384 *G-AASP*, 23.4.31, Imperial Airways Ltd. "Achilles", destroyed 3.4.40; 388 *VH-UNA*, 5.3.30, A.N.A. "Southern Sun", crashed at Alor Star in Malaya 26.11.31; 468 *VH-UPI*, completed 24.6.30, Queensland Air Navigation Co. Ltd., to New England Airways 12.31 as "City



of Sydney", to Airlines of Australia Ltd., s.o.r. 9.38; 524 *VT-ACT*, C. of A. 6.11.31, Indian State Airways; 525 *G-ABSP*, 22.12.31, to Egyptian Army Air Force 1.32 as *F200*, crashed at Assuit in Egypt 10.12.33; 526 *G-ABSR*, 29.12.31, to Egyptian Army Air Force 1.32 as *F201*, to Indian National Airways 9.34 as *VT-AFX*; 527 *G-ACGF*, 3.5.33, Midland and Scottish Air Ferries Ltd., s.o.r. 12.46; 528 *G-ABLU*, 18.6.31, Imperial Airways Ltd. "Apollo", crashed at

Ruysselede in Belgium 30.12.33; *K2682* completed 3.7.36 to Works Order 3302 and delivered to the R.A.F. 24.7.36 under Contract 164779/32, used by the Wireless and Equipment Flight at the R.A.E., Farnborough 27.7.36–28.10.36.

Note: Australian National Airways machines had Lynx IVB, and construction sequence was by C. of A. date with c/n 241 first.

(*b*) **Avro 619 Five**

Four aircraft as follows: c/n 228 *VP-KAE*, C. of A. 3.10.29, Wilson Airways Ltd. "Knight of the Grail", withdrawn from use 10.35; 370 *VH-UNK*, 16.12.29, Queensland Air Navigation Co. Ltd., crashed at Maryborough, Q. 31.12.30; 383 *G-AASO*, 10.3.30, damaged beyond repair at Broken Hill, Kenya 18.1.32; 436 *VP-KAD*, 22.1.30, Wilson Airways Ltd. "Knight Errant", broken up at Nairobi 10.32.

(*c*) **Avro 624 Six**

Three aircraft as follows: c/n 457 *G-AAYR*, 25.6.30, converted to six seat Avro Five, to China via Hong Kong 12.31 as *VR-HAQ*; 458 *G-ABBY*, 8.4.31, converted to six seat Avro Five for A.S.T. Ltd. 5.33, scrapped at Hamble 3.41; 575 *VR-HBF*, 14.1.32, Far East Aviation Co. Ltd., sold in China.

(*d*) **Avro 642/2m**

One aircraft as follows: c/n 642 *G-ACFV*, C. of A. 29.1.34, Midland and Scottish Air Ferries Ltd. "Marchioness of Londonderry"; wrecked at Cerrig-y-Druidion, Merioneth, Wales 4.6.34; rebuilt for Commercial Air Hire Ltd. 5.35; to W. R. Carpenter Ltd., Wau, N.G. 9.36 as *VH-UXD*; to Mandated Airlines Ltd. 3.37; destroyed by enemy action 11.3.42.

(*e*) **Avro 642/4m**

One aircraft as follows: c/n 773 *VT-AFM*, 8.12.34, Indian Government "Star of India"; to the R.A.F. 1939 as *L9166*; dismantled at Delhi 1940.



K1230, first Avro 621 Trainer delivered to the Air Ministry, flying over Gosport in 1933. ('*Flight*' *Photo 12311.*)

Avro 621 Tutor

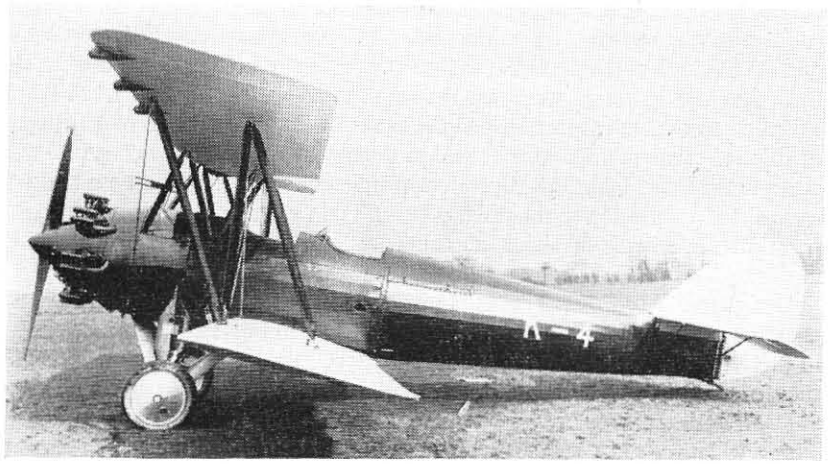
Tests made at Newton Heath with Fokker-type welded steel structures had shown that they were far stronger than the wooden equivalent and that the tubes did not corrode internally as had been feared. In extremes of temperature overseas, the advantages of a rugged, non-warping structure of this kind were obvious and numerous metal Avians were already behaving very satisfactorily in Canada, Australia, Africa and elsewhere. This form of construction was selected therefore for the Avro 621 two seat basic trainer, designed in 1929 by Roy Chadwick to replace the grand old 504N in R.A.F. service. The new aircraft was a heavily staggered, equal span biplane of strictly conventional appearance, with enlarged Avian-type horn balanced rudder. It was powered by an uncowled 155 h.p. Armstrong Siddeley Mongoose IIIA five cylinder radial behind which the rectangular section of the basic fuselage structure was brought up to streamlined form by large fabric covered removable inspection panels. Mainplanes, also fabric covered, were of all steel construction, wire braced and supported on narrow chord N-type interplane struts. Handley Page slots were standard and Frise-type ailerons were fitted to the lower mainplane only. Twin oil damped rubber-in-compression undercarriage shock absorbers were housed in wide streamlined fairings.

Designated Avro 621 Trainer and allotted civil markings *G-AAKT*, the prototype was submitted to Martlesham in December 1929 and first shown in the New Types Park at the Hendon R.A.F. Display on June 28, 1930 and then entered in the King's Cup Race of July 5 by the designer. Flown by J. L. N. Bennett Baggs, it averaged 108·3 m.p.h. from Hanworth to Woodford where it retired, but although no racer its handling qualities were superb, rivalling even those of the 504N. Two batches of Trainers *K1230–K1240* and *K1787–K1796* were then ordered by the Air Ministry to Specification 3/30

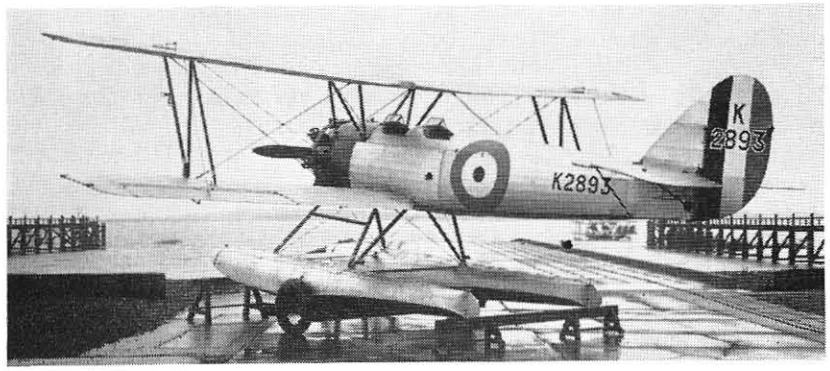
for Service trials at Gosport; No. 3 F.T.S., Grantham; and elsewhere during 1930. In March of that year three others were supplied to the Irish Army Air Corps which bestowed its own name Triton for instructional purposes at Baldonnel. One other was supplied in civil marks as *VH-UOL* to Australian National Airways Ltd.

The original design provided for the alternative installation of a 240 h.p. Armstrong Siddeley Lynx IVC and this engine was fitted to the majority of production aircraft. Two further prototypes *G-AARZ* and *'TU* were built with this engine and given enlarged and rounded rudders. Flown initially as *G-AARZ* but later as *K-4*, the first of these was otherwise similar to the first machine *'KT* and forerunner of special camera-equipped specimens *G-ABAP*, *'AR* and *'HA* which the Director of Surveys, Tanganyika, added to his Avian fleet. Standard Avro 621s were supplied to the Ottawa Car Co. Ltd. and the Far East Aviation Co. Ltd. who needed them urgently for demonstration to the rapidly expanding Royal Canadian and Kwangsi Air Forces respectively. Both later placed large orders.

Prototype trials, and the testing to destruction of a works aircraft *G-ABFL*, led to the adoption of the Avro 621 in June 1932 as the standard R.A.F. trainer under the Service name of Avro Tutor. Contracts were initially to Specification 18/31, but as a result of Martlesham trials with *K1797* and the remaining prototype *G-AARZ*, later batches were to Specification 25/32 with undercarriage moved forward $4\frac{3}{4}$ in., Dunlop intermediate pressure wheels, brakes, Frise ailerons on all four wings, and duplicated bracing wires. By 1934 developed Tutors were in production to Specification 24/34 with low drag undercarriages, Goodyear Airwheels, Townend rings, and eventually (after tests with *K3189* in November 1933) a tie rod between the ailerons as



K-4/G-AARZ, first prototype Avro 621 Tutor, with rounded rudder and ailerons on the lower mainplane only.



K2893, the Avro 646 Sea Tutor trials aircraft. (*Crown Copyright Reserved.*)



A production Avro 621 Tutor with four Frise ailerons, long travel undercarriage and Dunlop wheels. (*'Flight' Photo 12934.*)

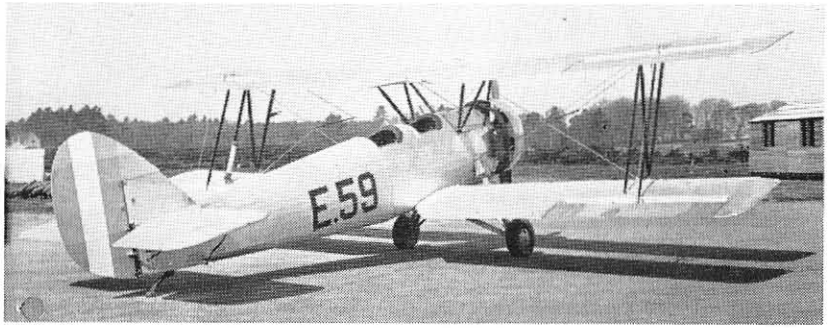
well as the original balance cable. Performance tests with the Townend ring were made with *K1797*, but commencing *K3219* all had this refinement. Brakes and a tail wheel were adopted for the final R.A.F. batches after trials with *K3248* but the Avro 621 Mk. II, *K3308*, fitted with two bay wings and tested at Martlesham in 1936, was the only one of its type.

At least two of the original R.A.F. Mongoose Trainers were sold to civil operators in 1934 and several others became instructional airframes. Survivors were posted to the Air Navigation School at Andover in 1935 but were struck off charge and broken up in 1937. Main Tutor production to meet R.A.F. and overseas orders progressed very rapidly by means of newly devised mass production methods using jig-built components to ensure complete interchangeability. It ceased in May 1936 with the completion of the 795th aircraft. All construction work took place in the Newton Heath works, but as soon as

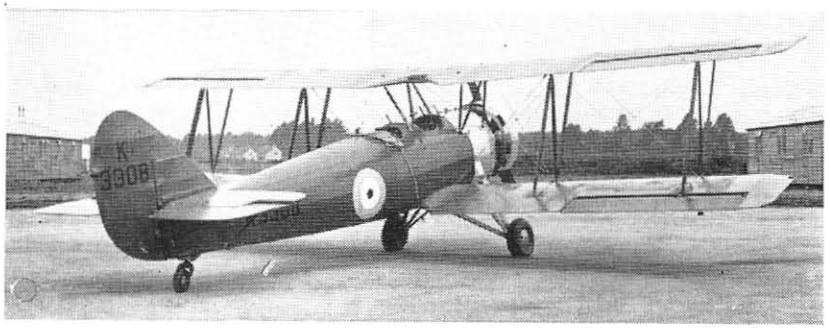
engine, centre section and undercarriage had been fitted, the Tutors were towed 15 miles behind a lorry to Woodford Aerodrome for rigging and flying. They were issued to the Central Flying School; the Flying Training Schools; the R.A.F. College, Cranwell; the University and Auxiliary Squadrons; and in later years to the Elementary and Reserve Training Schools. They took over the formation, aerobatic and inverted flying turn at the Hendon R.A.F. Display, commencing with a C.F.S. team flying *K3237–K3242* at the display of June 26, 1933.

Two early model Tutors, *113* and *114*, ordered by the Danish Navy, arrived at Copenhagen in crates on January 4, 1932. Locally designated L.B. IV, they were later brought up to late production standard and supplemented by *115* equipped with long chord cowlings and revised aileron circuit without the connecting strut or cable. Tutor *115* was delivered without covering as a pattern for licence production by Orlogsvaerftet (Danish Naval Dockyard) but only three were built in Denmark. Skis from a Hawker Danecock were fitted to one of them in 1938.

As a result of trials in Greece with civil demonstrator *G-ADMG*, a large batch was sold to the Greek Air Force; two were also acquired by the Polish Ministry of Communications, Warsaw, in May 1935; and two others, *701* and



A Greek Air Force Tutor showing the aileron link strut fitted to late production aircraft.



The experimental two bay Avro 621 Tutor Mk. II *K3308*.



Danish Navy Tutor *115* with long chord cowling.

702, were evaluated at Roberts Heights by the South African Air Force, which then acquired a licence to build 57 machines at the Aircraft and Artillery Depot, Pretoria. Improved versions similar to the Egyptian and Brazilian Avro 626s (see page 293), considered in March 1935 as the Avro 662 with Lynx and as the Avro 669 with Cheetah IX, remained only projects.

Early production Tutors *G-ABIR* and *'IS* were used for advanced flying instruction at Hamble by Air Service Training Ltd. from 1931 until the outbreak of war. As at C.F.S., they were used to teach blind flying techniques first developed on the old hooded 504Ns, and during 1934 were brought up to the full modification standard of later R.A.F. batches. Trials at Hamble and the M.A.E.E., Felixstowe, with a civil seaplane prototype *G-ABGH* (Lynx IVC) led to the temporary use of *'IR* for seaplane instruction in the summer of 1932 and to the placing of an Air Ministry order for one trials aircraft and 14 production Avro 646 Sea Tutors to Specification 26/34. Equipped with floats built to Specification 17/33, they were delivered 1934–36 and used for waterborne trials at Felixstowe and by the Seaplane Training School, Calshot, until withdrawn in April 1938.

In the winter of 1932–33, civil Tutors *G-ABZP* and *'ZR*, supplied to Sir Alan Cobham's Circus for aerobatic joyrides, joined the prototype machine *G-AARZ* on a South African tour piloted by C. W. Bebb, Martin Hearn and others. After the loss of *'ZR* in a fatal crash, the other two were shipped back to the U.K. in readiness for the 1934 season during which *'RZ* was damaged beyond repair. In the same year *G-ACOV* (formerly *K1791*, one of the original R.A.F. Mongoose Trainers), was overhauled for similar use by Air Pageants Ltd. and in 1936 an even earlier specimen, *K1231*, was converted at Eastleigh for private owner T. C. S. Westbrook and registered *G-ADYW*. This was later used by Grimsby Aviation Ltd. by whom it was scrapped in 1940. Air Service Training machines *'IR* and *'IS* served with No. 3 E.F.T.S.,

Hamble, until impressed at the end of 1941 and eventually handed over to the Air Training Corps as instructional airframes. In April 1940 this fate befell *G-AFZW* (formerly *K3237*, starboard outer machine of the 1933 R.A.F. Display aerobatic flight) belonging to Portsmouth, Southsea and Isle of Wight Aviation Ltd.

Among redundant Service stocks after the war were a number of Tutors, of which three were disposed of to civilians. The first, *G-AHSA* ex *K3215*, was converted at Weston-super-Mare for the Darlington and District Aero Club in February 1947; *K6105* was rebuilt as *G-AKFJ* by W. Sturrock, Avro manager at Bracebridge Heath, near Lincoln, in 1948; but *K3363*, actual machine used in the comic event at the 1935 R.A.F. Display, languished untouched at Croydon for some years without becoming *G-AIYM*. Sole surviving Tutor in the U.K. in 1963 was the former *G-AHSA*, preserved in flying condition with original serial *K3215* by the Shuttleworth Trust.

SPECIFICATION AND DATA

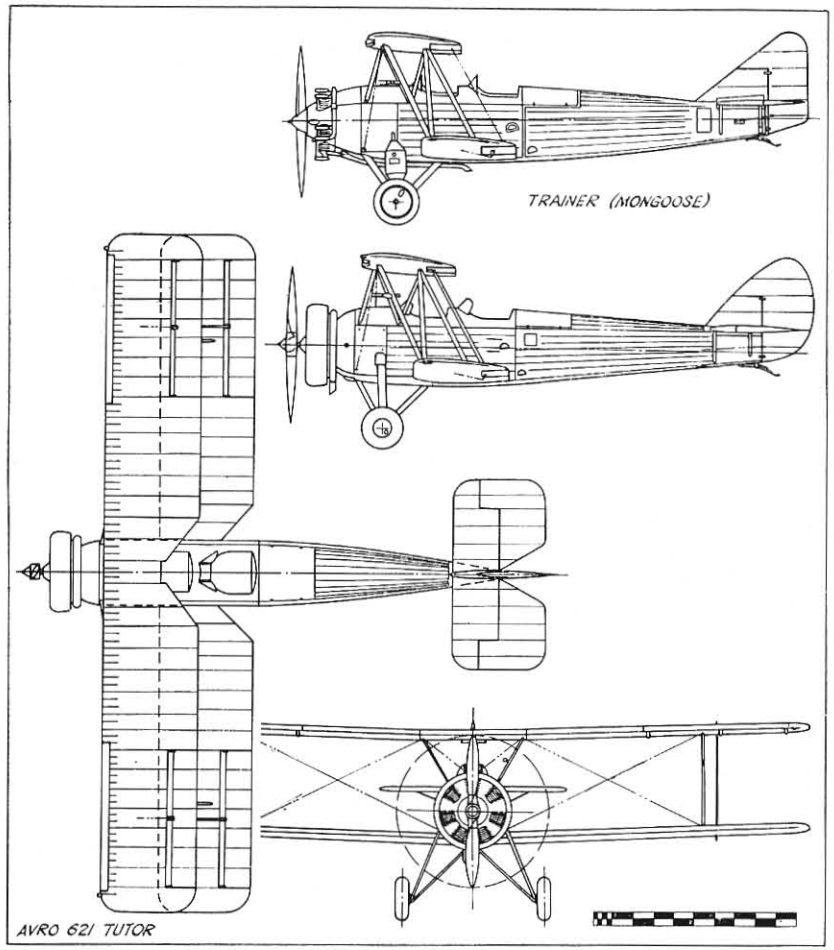
Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Hamble Aerodrome, near Southampton, Hants.
Orlogsvaerftet (Royal Danish Shipyard), Copenhagen, Denmark
South African Air Force, Aircraft and Artillery Depot, Pretoria

Power Plants: One 155 h.p. Armstrong Siddeley Mongoose IIIC (designated Mongoose IIIA in civil machines)
One 180 h.p. Armstrong Siddeley Lynx IV
One 240 h.p. Armstrong Siddeley Lynx IVC

Dimensions, Weights and Performance:

	Avro 621		Avro 646 Sea Tutor
	Mongoose IIIC	Lynx IVC	
Span	34 ft. 0 in.	34 ft. 0 in.	34 ft. 0 in.
Length	26 ft. 7¾ in.	26 ft. 4½ in.	29 ft. 3 in.
Height	9 ft. 7 in.	9 ft. 7 in.	11 ft. 6 in.
Wing area	302 sq. ft.	301 sq. ft.	300 sq. ft.
Tare weight	1,535 lb.	1,844 lb.	2,218 lb.
All-up weight	2,182 lb.*	2,493 lb.*	2,894 lb.
Maximum speed	104 m.p.h.	120 m.p.h.*	92 m.p.h.
Cruising speed	95 m.p.h.	97 m.p.h.	95 m.p.h.
Initial climb	725 ft./min.*	910 ft./min.	430 ft./min.
Ceiling	12,400 ft.	16,000 ft.	12,000 ft.
Range	380 miles	250 miles	240 miles

**G-AAKT* 1,571 lb., 2,230 lb., and 650 ft./min. respectively.
**Avro 621 Mk. 2 *K3308* all-up weight 2,687 lb.



Production:

(*a*) **Avro 621 prototypes, civil and export orders**

Constructor's Numbers	Aircraft markings
321, 322, 410–413	*G-AAKT*, *G-AARZ*/*K-4*, Irish *A.7-A.9*, *VH-UOL*
437, 463, 464, 477	*G-AATU*, *CF-ANQ*/R.C.A.F. *224*, *VR-HAF*, *G-ABFL*
485, 497, 498	*G-ABGH*, *G-ABIR*/*HM504*, *G-ABIS*/*HM505*
506–516	R.C.A.F. *184-189*, Kwangsi Air Force (5)
550, 551, 774	Danish Navy *113-115*
624, 625, 638, 641	*G-ABZP*, *'ZR*, S.A.A.F. *701*, *702*
795, 826, 827	*G-ADMG*/Greek Air Force *E-69*, Poland (2)
891–919	Greek Air Force *E-50* to *E-68* and *E-70* to *E-79*

(*b*) **Avro 621 survey version**

Three aircraft for the Director of Surveys, Tanganyika: c/n 461, 462, 487; *G-ABAP*, *'AR* and *'HA*; Cs. of A. issued 18.7.30, 30.9.30 and 4.3.31; to Tanganyika 2.32 as *VR-TAB*, *'AC* and *'AE*; impressed locally 1940.

(*c*) **Avro 621 Trainers** (Mongoose IIIC)

Eleven aircraft *K1230–K1240* requisitioned 3.30; a further ten *K1787–K1796* requisitioned 10.30. (Civil conversions: *K1231* for T.C.S. Westbrook as *G-ADYW*, C. of A. issued 23.6.36, to Grimsby Aviation Ltd., scrapped at Waltham 1940; *K1791* for Air Pageants Ltd., as *G-ACOV*, C. of A. issued 29.5.34, crashed 12.34).

(*d*) **Avro 621 Tutors** (Lynx IVC)

Contract	Quantity	Serials	Contract	Quantity	Serials
—	1	*K1797**	195190/32	94	*K3381–K3474*
113780/31	18	*K2496–K2513*	350988/34	40	*K4798–K4837*
195190/32	30	*K3189–K3218*	411542/35	40	*K6087–K6126***
195190/32	153	*K3219–K3371*	411542/35	5	*K8168–K8172*

*Wrecked in landing collision 24.4.35. **All delivered to No. 2 A.S.U.

(Civil conversions: *K3215* to Darlington and District Aero Club Ltd., as *G-AHSA*, C. of A. issued 20.7.47, preserved by the Shuttleworth Trust; *K3237* to Portsmouth, Southsea and Isle of Wight Aviation Ltd. as *G-AFZW*, C. of A. issued 3.4.40, to No. 15 M.U., Wroughton 29.4.40 as *AV980*, instructional airframe 1.41 as *2427M*; *K3363* by road to Burton-on-Trent 1950 before conversion to *G-AIYM*; *K6105* to W. Sturrock, Bracebridge Heath, as *G-AKFJ*, C. of A. issued 17.12.47, to Doncaster Ultra Light Group 1948, crashed at Doncaster 30.7.49).

(*e*) **Avro 646 Sea Tutors**

Contract	Quantity	Serials	Contract	Quantity	Serials
174901/32	1	*K2893**	335645/34	2	*K3475–K3476*
261030/33	9	*K3372–K3380*	419033/35	3	*K6923–K6925*

Also four engineless airframes in 1934 and three in 1936.
*Trials aircraft initially with Short metal floats, later with Avro-built floats.

(*f*) **Total production by A. V. Roe and Co. Ltd.**

Complete aircraft 1930–36: 436 military, 49 civil. Engineless airframes 1932–36: 303 military. Civil airframes: six in 1931 and one in 1938. Total production 795 aircraft.

(*g*) **Avro 621s built under licence**

South Africa: Fifty-seven aircraft, serials believed *703–759*.

Denmark: Three aircraft, *116–118*, Orlogsvaerftet c/n 86–89, on Danish Navy charge 24.6.35, 6.4.37 and 13.4.37 respectively. These and the Avro-built *114* and *115* were stored during the German occupation and believed destroyed when saboteurs blew up their hangar 22.11.43.

Service Use: (with specimen serials)

(Tutors) Central Flying School, Upavon, *K3203*, *'05*, *'37–'42*, *'48*, *'61–'65*, *K3362–'65*, *'69*; School of Air Pilotage, Andover, *K1233*, *'34*, *K1787–'96*; No. 2 F.T.S., Digby, *K4809*; No. 3 F.T.S., Grantham, *K1230*, *'33*, *'39*, *K2496–K2513*, *K2353*, *K4816*; No. 5 F.T.S., Sealand, *K3233*, *'43–'47*, *'49–'52*, *'63*, *'65*, *'66*, *'68*, *'70–'72*, *K3449*; No. 11 F.T.S. Wittering, *K3403*, *'73*; R.A.F. College, Cranwell, *K3198*, *K3205*, *K3461*; No. 23 E.R.F.T.S., Rochester, *K3244*, *'64*, *K3331*, *'67*, *K3419*; Oxford University Air Squadron, *K3271*, *'95*, *K3442–'44*, *'50*, *K4620*, *K4798*, *'99*, *K4820*, *'23*; Cambridge U.A.S., Duxford, *K3225*, *'26*, *'60*, *'74*, *'78–'83*, *K3341*, *K3430*, *'31*, *'36*, *'70*, *K4798*, *K4830*, *'32*; London U.A.S., *K3215*, *'48*, *'71*, *K3302*, *'07*, *'91*, *K3406*, *'53*, *'73*, *'74*, *K4828*, *'29*, *K6123*, *'24*; No. 600 Sqn. A.A.F., Hendon, *K3266*, *K3326*, *'84*, *K3471*; No. 601 Sqn. A.A.F., Hendon, *K3360*, *K3442*; No. 605 Sqn. A.A.F., Castle Bromwich, *K3309*, *K3458*; No. 609 Sqn. A.A.F., *K3433*; No. 610 Sqn. A.A.F., *K3307*, *'11*; No. 614 Sqn. A.A.F., *K6104*; No. 24 (Communications) Sqn., Hendon, *K6090*; Hong Kong Volunteer Air Force, Kai Tak, *K3309*, *K3439–'41*; R.C.A.F. School of Army Co-operation, Camp Borden.

(Sea Tutors) Seaplane Training Sqn., Calshot, *K2893*, *K3373–'77*; D.T.D. trials *K3372*; stored *K3378–'80*.



A Cheetah V powered Avro 626 of the Brazilian Air Force. (*'Flight' Photo 13892.*)

Avro 626 and Variants

To satisfy the needs of foreign air forces having only limited financial resources, the Tutor was redesigned in 1930 and offered as the unnamed Avro 626, with conversion kits to make it suitable for initial flying training, or bombing, photographic, gunnery, wireless, night flying, navigation, blind flying and seaplane instruction. Although the machine remained a two seater, a third cockpit or gunner's position was provided aft of, and in communication with, the rear cockpit.

An early demonstrator, *G-ABFM*, was taken in crates by cargo steamer to the British Empire Trade Exhibition in Buenos Aires in January 1931, where it was flown by Capt. Norman Macmillan as a landplane at the Argentine Air Force base; and on both wheels and floats at the naval base at Bahia Blanca. The same pilot then made the first all-British crossing of the Andes during a round trip from Buenos Aires to Bahia Blanca, Neuquen (North Patagonia), Chillan, Santiago and Mendoza. On its return *G-ABFM* was commandeered on the spot by the Argentine military authorities to help quell a provincial uprising, and performed so well that 14 additional Avro 626s were purchased a few months later.

Resulting from the Avro company's brilliant appraisal of overseas requirements and the untiring efforts of their globetrotting demonstrators *G-ABGG*, *'JG*, *'RK* and *G-ACFW*, the 626 went into large scale production. *G-ACFZ*, a seaplane with Short all-metal floats and flown initially from Hamble slipway, was demonstrated and sold in Brazil in 1933; *G-ADKZ* and *'UJ* in Czechoslovakia and Austria respectively in 1935; and six others were ferried to Austria in British marks 1936–37. Considerable foreign contracts resulted

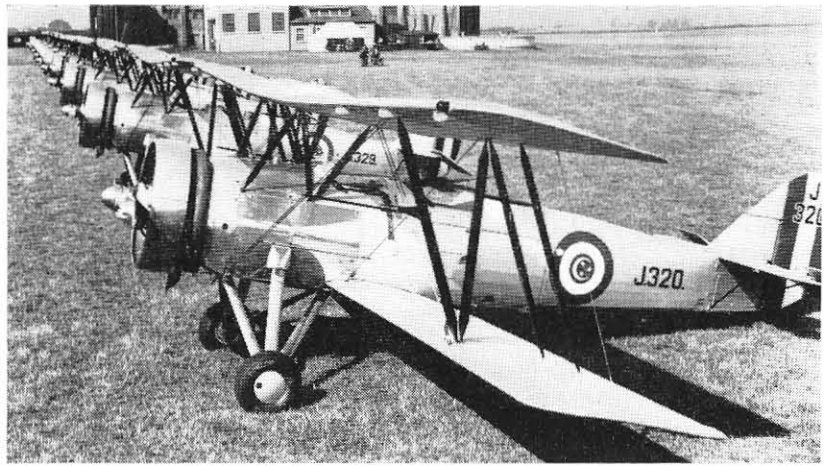
and when production ceased in 1939, Avro 626s were in service with the air forces of Argentina, Austria, Belgium, Brazil, Canada, Chile, Czechoslovakia, Egypt, Greece, the Irish Free State, Kwangsi Provincial Government (South China) and Lithuania. Four for Estonia were supplied with interchangeable float undercarriages after waterborne trials at Hamble with *142*. The first for Chile was flown over the Andes in December 1934 by Avro chief test pilot H. A. Brown in mid-winter at an all-up weight of 3,250 lb.

After the delivery of 26 aircraft, the Portuguese Government aircraft factory OGMA acquired a licence to build Avro 626s locally for the Navy and 5a Arma. Some R.C.A.F. machines e.g. *225*, were equipped with twin metal skis, cabin tops and Arctic cowlings with controllable shutters.

The Avro 626 was not a civil type and the demonstrators bore civilian marks purely for test or to facilitate their passage abroad. The exceptions were *G-ABRK*, flown by the Earl of Amherst at Heston, and *G-ABYM*, the Air Service Training Ltd. radio trainer. Apart from a trip to Cairo in December 1933 for the Circuit of the Oases Rally piloted by W. D. Campbell (who handed over to F/Lt. R. P. Pope on arrival) it was in constant use at Hamble until scrapped in 1939. Rally competitors were shepherded across the desert by four Egyptian Army Air Force Avro 626s, ten of which had been delivered a month previously for survey work and anti-hashish patrols over the Sinai Desert. Egyptian pilots were given a familiarisation course at Lympne prior to a formation delivery flight begun on November 18, but two crashed and burned in fog in France and replacements were built later. All the Egyptian Avro 626s, including ten delivered in 1937 to form No. 1 (General Purpose) Squadron, were of an improved type with 260 h.p. Armstrong Siddeley



G-ABGG, one of the early-type Avro 626s used by A. V. Roe and Co. Ltd. as a demonstrator.



Egyptian Army Air Force Avro 626s (with aileron link struts) ready for delivery at Lympne ;November 1933. (*'Flight' Photo 10809S.*



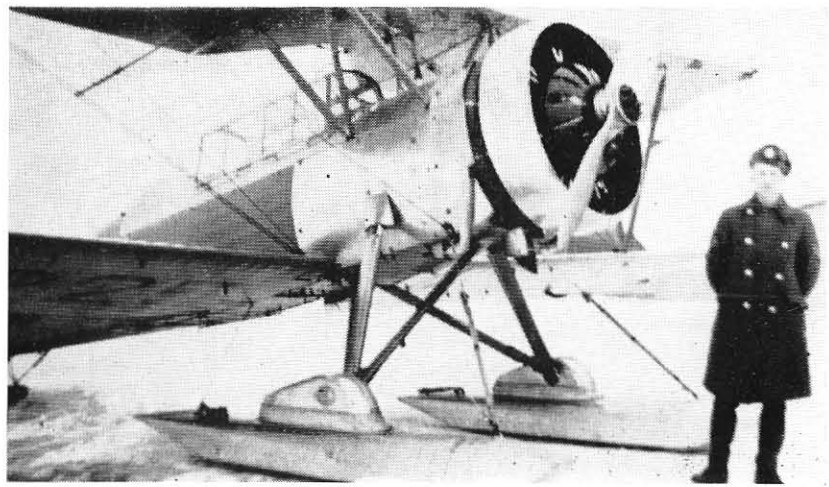
The Avro 626 civil floatplane demonstrator *G-ACFZ* at Hamble before despatch to Brazil.

Cheetah V. Seventeen with this engine and inscribed 'Exercito' later joined demonstrator *G-ACFZ* in Brazil.

The only versions significantly different from standard were the Avro Prefect and the Avro 637. The first was a specialised navigation trainer developed for the R.A.F. via a conversion of the Tutor *K3221* illustrated on page 285. Seven built to Specification 32/34 replaced the old Mongoose Trainers at the School of Air Navigation, Andover, in 1935. They were merely two seat Tutors brought up to full Avro 626 condition (but without the third cockpit), and equipped with tail wheels and modified aileron circuits.

During their Service life these machines were known simply as Avro Prefects without type number, to distinguish them from the Avro 626. The only other Prefects were four supplied to the R.N.Z.A.F. in 1935, but these were variants having the third cockpit. After the Second World War, two Prefects *K5069* and *K5066* were overhauled by Southern Aircraft (Gatwick) Ltd. and flown a little in 1946 as civil machines. In New Zealand, Prefect *NZ203* was converted for private owner J. Frogley at Havelock North in 1947 as *ZK-APC* and was still extant in 1963.

The Avro 637 was a lightly armed frontier patrol aircraft with rounded wing tips giving slightly increased span. Only eight were built, all supplied to the Kwangsi Air Force at Luichow, South China by the Far East Aviation Co. Ltd., Hong Kong, following demonstrations at Yunnanfu by Capt. G. S. Jones-Evans D.F.C. in 1934. The development vehicle for the Avro 637 was *G-ABJG*, which in B conditions as K-10, was modified repeatedly during 1932–33 until the desired configuration was arrived at, and then submitted for Air Ministry trials at Andover in 1934. The pilot, who occupied the front seat and was protected by a tunnel-like windscreen, was armed with one Vickers gun on top of the fuselage. His observer in the rear was provided with one Lewis gun on an Avro low-drag mounting. A large additional fuel tank was installed in the front fuselage and the engine was a Cheetah V driving a metal airscrew. As well as 400 rounds of ammunition the machine would carry six 20 lb. bombs and vertical camera, or four bombs and radio equipment. If required, the rear decking could be hinged to take a stretcher case behind the pilot.



225, a R.C.A.F. Avro 626 with skis, enclosed heated cockpits, and Arctic engine cowling.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester
Oficinas Gerais de Material Aeronautico, Alverca do Ribatejo, Portugal

Power Plants: (Avro 626) One 240 h.p. Armstrong Siddeley Lynx IVC
One 260 h.p. Armstrong Siddeley Cheetah V
(Avro 637) One 260 h.p. Armstrong Siddeley Cheetah V

Dimensions, Weights and Performances:

	Avro 626 (Lynx IVC)		Avro 626 (Cheetah V)		Avro 637
	landplane	seaplane	landplane	seaplane	
Span	34 ft. 0 in.	34 ft. 0 in.	34 ft. 0 in.	34 ft. 0 in.	36 ft. 0 in.
Length	26 ft. 6 in.	29 ft. 4 in.	26 ft. 6 in.	29 ft. 4 in.	27 ft. 3 in.
Height	9 ft. 7 in.	11 ft. 6 in.	9 ft. 7 in.	11 ft. 6 in.	9 ft. 9 in.
Wing area	300 sq. ft.	300 sq. ft.	300 sq. ft.	300 sq. ft.	314 sq. ft.
Tare weight	1,765 lb.	2,026 lb.	2,010 lb.	2,305 lb.	1,987 lb.
All-up weight	2,750 lb.	2,735 lb.	2,667 lb.	2,963 lb.	3,127 lb.
Maximum speed	112 m.p.h.	108 m.p.h.	130 m.p.h.	120 m.p.h.	135 m.p.h.
Cruising speed	95 m.p.h.	90 m.p.h.	108 m.p.h.	100 m.p.h.	115 m.p.h.
Initial climb	880 ft./min.	675 ft./min.	1,000 ft./min.	850 ft./min.	990 ft./min.
Ceiling	14,800 ft.	14,000 ft.	16,800 ft.	13,700 ft.	16,000 ft.
Range	240 miles	240 miles	210 miles	200 miles	540 miles

Note: Figures quoted for the Avro 626 are for aircraft equipped for initial flying instruction. Those for the Avro 637 are for an unarmed aircraft, performance figures for the two main roles being given below.

	Max. speed	Cruise	Climb	Ceiling	Range
With bombs	130 m.p.h.	110 m.p.h.	900 ft./min.	14,000 ft.	300 miles
Fighter	137 m.p.h.	116 m.p.h.	1,160 ft./min.	17,500 ft.	450 miles

Production:

(*a*) Avro 626 prototypes, civil and export orders

Constructor's Numbers	Aircraft markings
476, 478, 496, 553	*G-ABGG*/*K-7*, *'FM*, *'JG*/*K-10*, *'RK*
569, 570, 620, 634	*VR-HAU*, *'AW*, *'BZ*, *'CA*
622, 643, 648, 862	*G-ABYM*, *G-ACFZ*, *'FW*, *G-ADKZ*
868	*G-ADUJ*
923–925, 982–984	*G-AEGA*–*'GC*, *G-AEVI*–*'VK*

Demonstration aircraft: *G-ABRK* Persia; *G-ACFW* Belgium; *G-ACFZ* Finland and Brazil.

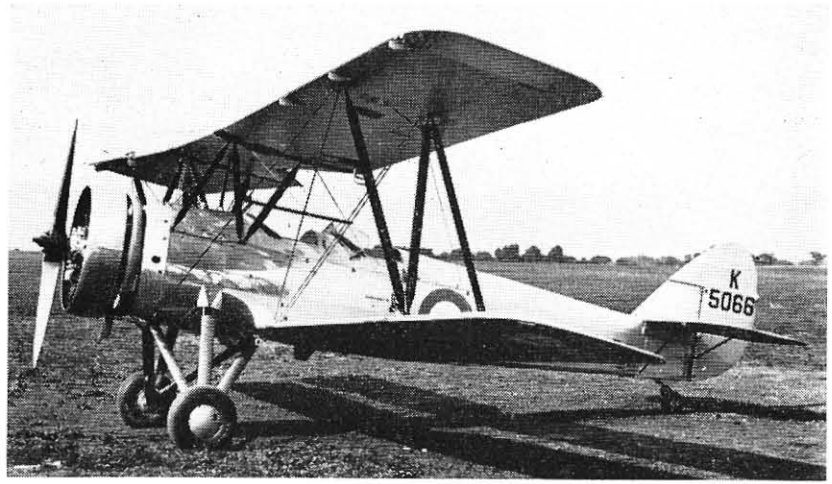
(*b*) Avro 626 military production

Constructor's Numbers	For	Serials	Constructor's Numbers	For	Serials
517–521	China		828–847	Chile	*1* to *20*
536–549	Argentina		869, 890	Portugal	
571–574	China		927–929	R.C.A.F.	*225* to *227*
593–596	Estonia	*141*, *143*, *144*, *142*	930–938	Greece	*TT1* to *TT9*
668–677	Egypt	*J300* to *J309*	952–966	Brazil	*1* to *15*
680	Egypt	*J310*	996–1007	Portugal	
687–690	Ireland	*A.10* to *A.13*	1070–1078	R.C.A.F.	*266* to *274*
695, 793	Egypt	*J311*, *J312*	1089–1090	Lithuania	
703, 797	Lithuania		1091–1098	Portugal	
761–770	Egypt	*J320* to *J329*	1099–1110	Greece	*TT10* to *TT21*
783–790	Belgium	*A-1* to *A-8*	1123–1126	Portugal	
799, 942, 950	Egypt	*J330*, *J331*, *J328**	1152	Egypt	*J332***
822–825	Belgium	*A-9* to *A-12*			

*Replacement aircraft with duplicated serial.
**Delivered 4.40 to Works Order 21050 with Avro 652 Mk. II *SU-AAO*.

(*c*) Avro Prefect

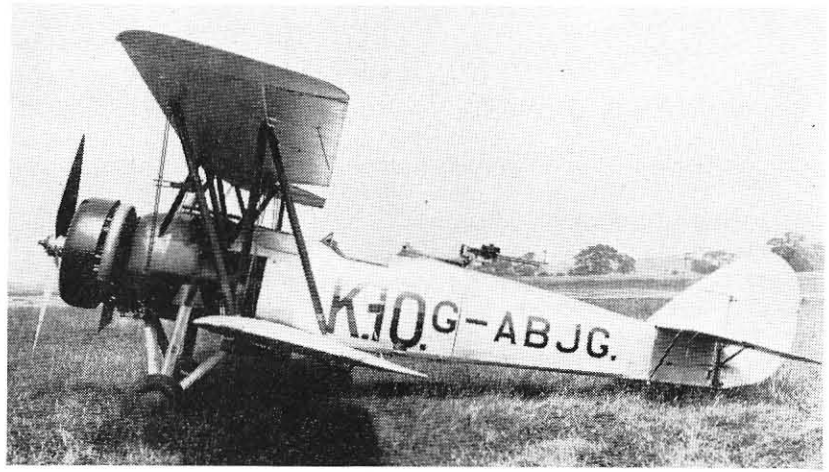
K5063-*K5069* to Air Ministry Specification 32/34 under Contract No. 368655/34, delivered to the R.A.F. January–July 1935; *NZ201*–*NZ204*, c/n 809–812, under Contract No. 36122/34 for the Royal New Zealand Air Force July 1935. (Civil conversions: *K5069* to *G-AHRZ*, C. of A. issued 27.7.46, broken up at Gatwick 1948; *K5066* to *G-AHVO*, C. of A. issued 9.7.46, broken up at Hastings 1950; *NZ203* to *ZK-APC* for J. Frogley 1947, still flying in 1963.)



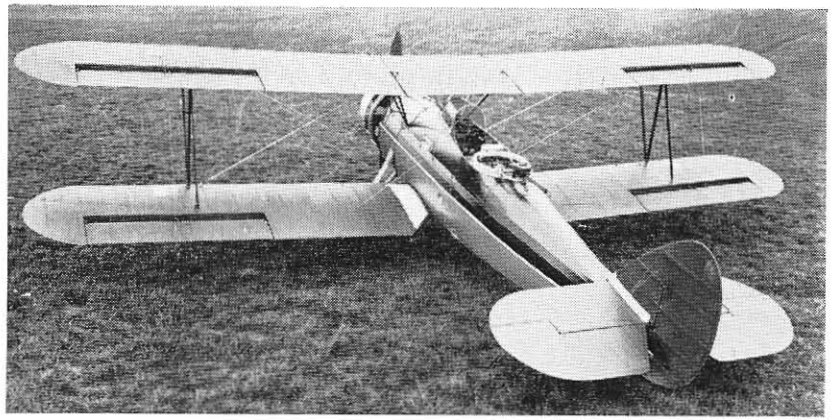
Avro Prefect *K5066* which in later years flew in civil guise as *G-AHVO*. (*'Flight' Photo 11629S.*)

(d) **Avro 637**

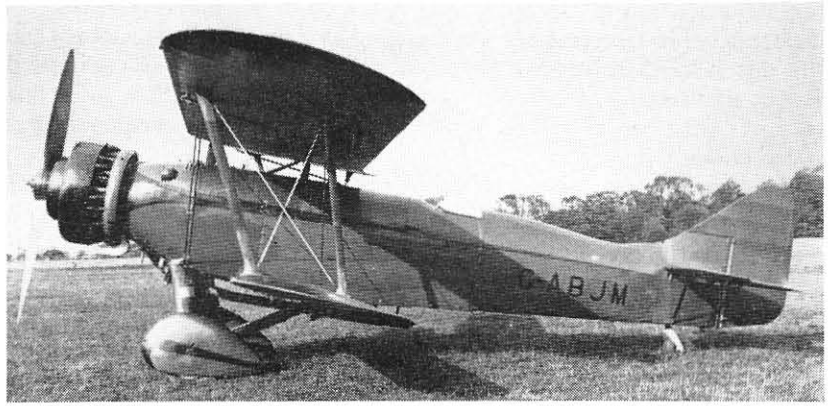
Eight aircraft, c/n 635–637, *VR-HCH*, *'CI* and *'CE*, Cs. of A. issued 24.5.33; c/n 662–665 and 681, unregistered, Cs. of A. issued 2.11.33, 6.11.33, 6.11.33, 15.1.34 and 15.12.33, supplied to the Kwangsi Air Force, Luichow, South China, by the Far East Aviation Co. Ltd., Hong Kong; Chinese serials around and about *112*.



G-ABJG/K-10 the Avro 637 development vehicle.



A standard Avro 637 with 'tunnel-type' windscreen for the Kwangsi Air Force, South China.



The Avro 627 Mailplane in standard form, 1931.

Avro 627 Mailplane

The Avro 604 Antelope was followed through the Newton Heath works by a second airframe, c/n 5125, intended as a private venture two seat fighter variant designated Avro 608 Hawk and powered by a Bristol Jupiter radial engine. Antelope mainplanes, interplane and centre section struts, tail unit and undercarriage were retained, but instead of being metal clad, the welded steel tube basic fuselage structure was rounded out with removable fabric covered panels to conform to the shape of the engine as on the Tutor series.

Armament, largely similar to that of the Antelope, consisted of two synchronised forward firing Vickers guns and a single Lewis on an Avro low drag, rotatable mounting. To permit the gunner to stand over his weapon without undue drag penalty, the rear cockpit was set deep in the curved rear decking.

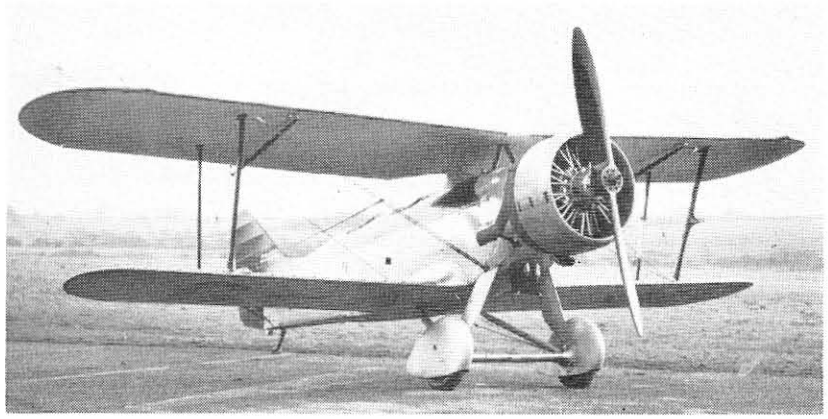
In accordance with normal practice for private venture military prototypes, application was made for civil registration and the marking *G-EBWM* was allotted on February 29, 1928. This lettering was never used because the Hawk remained incomplete until redesigned to take the 540 h.p. Armstrong Siddeley Panther II radial under designation Avro 622 in April 1930.

When Canadian Airways Ltd. started their Prairie Air Mail service between Winnipeg, Calgary and Edmonton in 1930, they issued a mailplane specification which closely resembled the Avro 622. Designs were consequently amended still further and the aircraft was completed as the single seat Avro 627 Mailplane to meet this requirement. Working in collaboration with officials of Canadian Airways Ltd., Roy Chadwick equipped the Avro 627 for ski or float operation, installed night flying equipment, inertia starting and a large 40 cu. ft. fire-and-waterproof mail compartment in the front fuselage. Powered by a 525 h.p. Armstrong Siddeley Panther IIA in a double Townend

ring, the machine was capable of long stages up to 560 miles. Pilot comfort in extremely low temperatures was therefore of considerable importance and with this in mind the cockpit was positioned well aft, to give an exceptional view in all directions. It was also provided with exhaust heating, adjustable seat and rudder bar, as well as such emergency and navigation equipment as existed at that time.

The Avro 627 was painted yellow overall, certificated on August 2, 1931 and demonstrated at Heston on August 10 for the benefit of the Air Minister, Col. Shelmerdine. It was then shipped to Canada for operational trials but unfortunately its arrival coincided with a Canadian Government decision to reduce drastically the annual allotment to civil aviation. Canadian Airways Ltd. were thus unable to afford new equipment and the Avro 627 returned to England in time for exhibition and demonstration at the Hendon S.B.A.C. Show on June 27, 1932. Entered by Sir John Siddeley and flown by Avro chief test pilot H. A. Brown, the machine came 29th in the King's Cup Race at Brooklands July 8–9, 1932 but set up the fastest speeds ever recorded in the race up to that time, averaging 175·5 m.p.h. to Woodford and back on the first day and 176·0 m.p.h. round shorter circuits on the second.

The machine's military potential was still evident but a further scheme for a Panther engined Avro 630 day bomber based on the Mailplane was eventually shelved, and the Mailplane itself returned to Woodford to re-emerge in June 1933 as the Avro 654 high performance single seat test bed for the 700 h.p. Armstrong Siddeley Tiger IV engine. The rear centre section struts were faired in and the undercarriage modified and equipped with long travel oleo legs. A skid replaced the tail wheel. On 30% more power, performance was spectacular and in November 1933 a flight observer's cockpit was fitted in place of the mail compartment, but its operational life was short and dismantling followed in 1934.



The Mailplane in November 1933 as the two seat Avro 654 Armstrong Siddeley Tiger test bed.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester

Power Plants:
(Avro 608) One 425 h.p. Bristol Jupiter
(Avro 622) One 540 h.p. Armstrong Siddeley Panther II
(Avro 627) One 525 h.p. Armstrong Siddeley Panther IIA
(Avro 654) One 700 h.p. Armstrong Siddeley Tiger IV

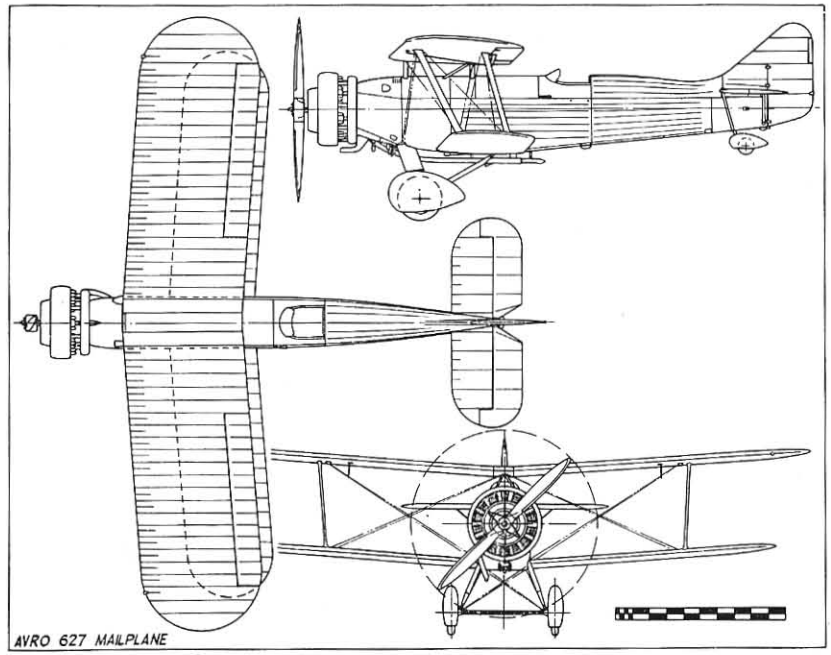
Dimensions: Span (upper) 36 ft. 0 in. (lower) 32 ft. 0 in.
Length 30 ft. 10 in. Height 10 ft. 10 in.
Wing area 381 sq. ft.

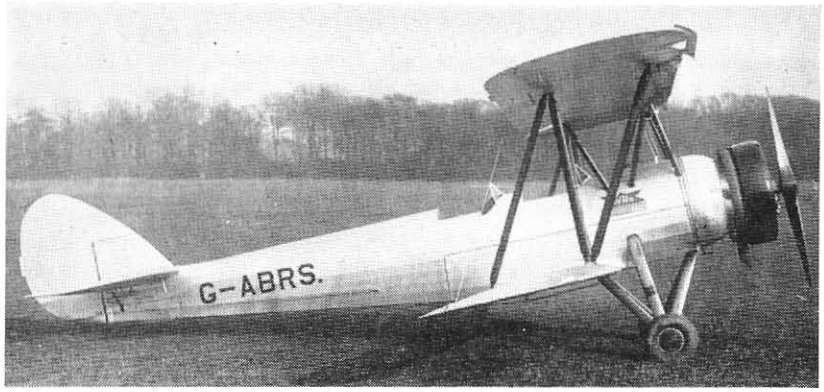
Weights: Tare weight 3,077 lb. All-up weight 5,150 lb.

Performance: Maximum speed 170 m.p.h. Cruising speed 147 m.p.h.
Initial climb 1,200 ft./min. Ceiling 19,000 ft.
Range 560 miles

Note: The above weight and performance figures refer to the standard Avro 627

Production: One aircraft only, conversion of unfinished Avro 608 Hawk *G-EBWM*, c/n 5125. Completed as Avro 627 Mailplane *G-ABJM*, c/n 502, C. of A. issued 2.8.31, converted 11.33 to Avro 654, dismantled 5.34





The prototype Avro 631 Cadet showing the short nose. (*'The Aeroplane' Photo.*)

Avro 631 and 643 Cadet

Produced in 1931 as a smaller version of the Tutor for club or private use, the Avro 631 Cadet bore a remarkable resemblance to the earlier machine, but differed slightly because wing and control surface structures were of wood. Registered *G-ABRS* in October 1931, the prototype made its first public appearance when Avro chief test pilot H. A. Brown gave an aerobatic display at the opening of Skegness Aerodrome on May 14, 1932 and Roy Dobson flew it into fourth place in a local race at 114 m.p.h. The Irish Army Air Corps, first foreign purchaser of the Avro 621, ordered six Cadets straight from the drawing board and these had already been delivered when the prototype made its debut.

Modifications considered in March 1932 for an Avro 633 Cadet Fighter, suitable for air forces of the smaller nations, were never made, and the type remained only a project. The standard Cadet was also offered as a seaplane but none, in fact, became marine aircraft.

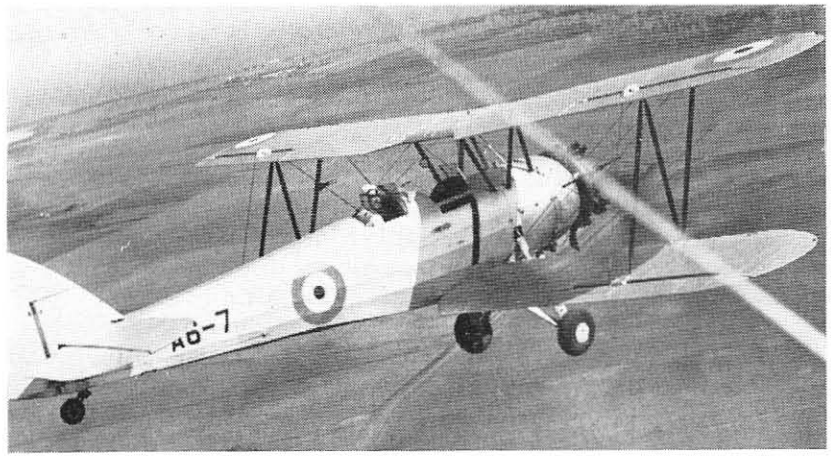
Although retaining the roomy cockpits and thoroughbred handling qualities of a generation of Avro trainers, the Cadet was fitted with the 135 h.p. Armstrong Siddeley Genet Major I seven cylinder radial and was consequently more expensive to run than contemporary two seat light aeroplanes. Also the staggered wings did not fold and the type found little favour as a private aircraft, the sole examples being the smart blue *G-ABVV* in which Maj. J. E. D. Shaw commuted between Kirbymoorside and Heston; *'YC* kept initially at Hamsey Green Aerodrome, Surrey by Gardners, the pre-war air racing family; and *'ZF* flown by F. G. Miles at Woodley.

By far the largest user was Air Service Training Ltd., Hamble, who quickly found it the almost perfect small aeroplane for ab initio flying instruction,

aerobatics or blind flying, and in the years 1932–34 the number of black and silver Cadets at Hamble reached a total of 17. All but six were still active at the outbreak of war in 1939 and remained on the strength of No. 3 E.R.F.T.S., Hamble, in camouflage with civil markings until moved to Watchfield in 1940 and eventual impressment as A.T.C. instructional airframes in 1941–42. A.S.T.'s associate, the Far East Aviation Co. Ltd., acquired the prototype Cadet *G-ABRS* in October 1934 for service with the Avian IVMs of the Far East Aviation School at Hong Kong. Later three others joined it and a fourth was demonstrated in China. The Irish Army Air Corps acquired a seventh, serial *C.7*, with inverted fuel system, which survived until the late 1950s when it was sold to a private owner and registered *EI-AFO*. The Portuguese Government acquired one Cadet for evaluation in 1934 leaving as the only other purchaser the Lancashire Aero Club, whose second Cadet *G-ACMG*, lost in a crash, was replaced by *G-ABYC* bought from Gardner.

The Avro 643 Cadet, introduced early in 1934, was an improved model with slightly more rotund fuselage and raised rear seat. Only eight were built including *G-ACZA* demonstrated far and wide by Henlys' test pilot A. ('G.B.') Golding-Barrett; one ferried to the Spanish concern Constructiones Aeronauticas S.A. as *EC-W26*; *G-ADEG* and *'FD* for flying clubs at York and Bristol; *G-ADEX* for the Hon R. F. Watson and *'IE* for Sir William Firth. The Avro 643 was merely the forerunner of the final and most widely used variant, the Avro 643 Mk. II Cadet* with the more powerful 150 h.p. Genet

*This designation has been misquoted frequently as Avro 643 Cadet Mk. II.



The Hon. R. H. Casey D.S.O., M.C., flying an Avro 643 Mk. II Cadet of the R.A.A.F. in 1938.



Avro 643 Mk. II Cadet *VH-BJB*, formerly *A6-34* of the R.A.A.F., with Wackett Trainer canopy. (*N. Wiltshire Photo.*)

Major IA. To accept this engine the front fuselage was lengthened by six inches and at the same time wing spars were strengthened; bracing wires were taken to the front wing root fitting for ease of parachute escape from the front cockpit; and full blind flying equipment was fitted as standard.

G-ADJT, the prototype Avro 643 Mk. II, was demonstrated at Croydon in September 1935 before sale in France. It was followed by *PP-TAF* for a Brazilian private owner and two for the Perak Flying Club. Major production, however, was for Air Service Training Ltd. and the Royal Australian Air Force. Those of the former served at No. 3 E.R.F.T.S., Hamble, and No. 9 E.R.F.T.S., Ansty, near Coventry, but in the early days of the war were moved to Watchfield and impressed, meeting the same fate as their sister machines, the Avro 631s. Proposals for an even later variant, the Genet Major engined Avro 663 Cadet Trainer, were dropped in the face of changing requirements arising from the Expansion Scheme.

In the British Isles two Avro 643s *G-ACIH* and *G-ADIE* alone flew again after the war. Both were resident at Weston Aerodrome, Leixlip, Eire from which the latter made a 200 mile trip to Waterford and back after restoration by Mr. M. Marron to attend the Tara Air Rally of June 4–5, 1960.

Thirty-four Avro 643 Mk. II Cadets, built at Manchester for the Australian Air Board, were delivered in three batches in November 1935, December 1937 and February 1939. Unlike the A.S.T. machines they were equipped with tail wheels and inverted fuel systems for use by the R.A.A.F. at No. 1 F.T.S., Point Cook, and by No. 21 (City of Melbourne) and No. 22 (City of Sydney) Citizen Air Force Squadrons. Survivors were sold in 1946 when 16 flew in civil marks, seven initially with the Newcastle Aero Club, N.S.W. Four were still extant in 1963, including *VH-BJB* with the sliding hood from a Wackett Trainer, and *VH-AFY* operated in Queensland by Hardy Bros. Spraying Co., who re-engined it with a 220 h.p. Jacobs R-755 radial.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester

Power Plants: (Avro 631) One 135 h.p. Armstrong Siddeley Genet Major I
(Avro 643) One 135 h.p. Armstrong Siddeley Genet Major I
(Avro 643 Mk. II)
One 150 h.p. Armstrong Siddeley Genet Major IA
One 220 h.p. Jacobs R-755

Dimensions, Weights and Performances:

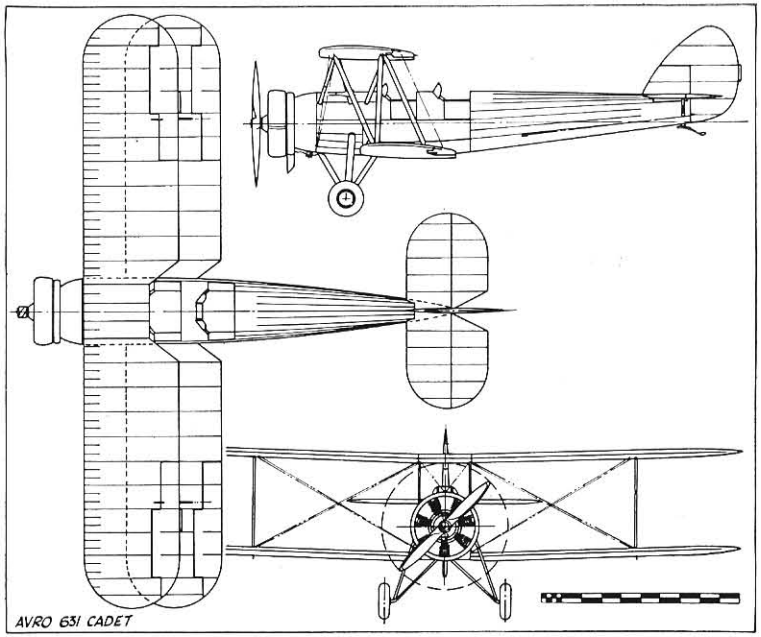
	Avro 631	Avro 643	Avro 643 Mk. II
Span	30 ft. 0 in.	30 ft. 2 in.	30 ft. 2 in.
Length	24 ft. 9 in.	24 ft. 9 in.	24 ft. 9 in.
Height	8 ft. 9 in.	8 ft. 9 in.	8 ft. 10 in.
Wing area	261¼ sq. ft.	262 sq. ft.	262 sq. ft.
Tare weight	1,180 lb.	—	1,286 lb.
All-up weight	1,900 lb.	2,000 lb.	2,000 lb.
Maximum speed	118 m.p.h.	—	116 m.p.h.
Cruising speed	100 m.p.h.	—	100 m.p.h.
Initial climb	600 ft./min.	—	700 ft./min.
Ceiling	13,000 ft.	—	12,000 ft.
Range	350 miles	—	325 miles

Production:

(*a*) **Avro 631 Cadet**

Constructor's No. and Registration		*C. of A. Issued*	*Details*
558	*G-ABRS*	15. 3.32	Sold to Far East Aviation School 10.34
581–86	*C.1–C.6*	nil	Irish Air Corps
589	*G-ABVV*	28. 5.32	Fatal crash at Kirbymoorside 30.5.39
592	*G-ABVU*	8. 6.32	Lancashire Aero Club, scrapped at Barton 5.51
597	*G-ABWJ*	18. 6.32	Demonstrator, sold in Brazil 1.37 as *PP-TJC*
621	*G-ABYC*	27. 7.32	Yardley and Co. Ltd.; to Lancashire Aero Club 1935; scrapped Barton 5.51
623	*G-ABZF*	4.10.32	Merseyside Aero and Sports Ltd., Hooton: to F. G. Miles, Woodley; scrapped 1936
678	—	27.12.33	For China via Far East Aviation Co. Ltd.
682	*G-ACMG*	3. 1.34	Lancashire Aero Club; damaged beyond repair at Adlington, Cheshire 3.12.34
683	*VR-HCL*	6. 1.34	To Far East Aviation Co. Ltd. for operation by Far East Flying School, Hong Kong
684	*VR-HCM*	8. 1.34	
685	*VR-HCN*	8. 1.34	
727	—	nil	To the Portuguese Government 6.34
730	*C.7*	nil	Irish Air corps; to R. A. Clark 8.50 as *EI-AFO*

Air Service Training Ltd. fleet: c/n 606–607, *G-ABWS*, *'XU*; 628–633 *G-ACCH-'CN*; 692–693, *G-ACNE-'NF*; 701–702, *G-ACRY*, *'RZ*; 724, 806, 805, 813, *G-ACUH*, *G-ADAU*, *'AV*, *'CX*.



(*b*) Avro 643 Cadet

Constructors No. and Registration		*C. of A. Issued*	*Details*
657	*G-ACIH*	9. 3.34	To Iona National Airways 4.61 as *EI-ALU*
758	*G-ACXJ*	12. 9.34	Demonstrator, scrapped during war
778	*EC-W26*	29.11.34	Constructiones Aeronauticas S.A., Spain
794	*G-ACZA*	23. 1.35	To the Perak Flying Club 1.38
817	*G-ADEG*	8. 4.35	York Aviation Country Club; scrapped at Tollerton 1950
819	*G-ADFD*	24. 5.35	Bristol Aeroplane Club; to Ferndown School A.T.C., Wimborne, Dorset 1951; scrapped 1961
820	*G-ADEX*	29. 5.35	Hon. R. F. Watson; to L. C. Lewis 1.37; sold abroad 9.37
848	*G-ADIE*	5. 6.35	Sir W. Firth; North of Ireland Aero Club 9.38; re-registered 9.60 as *EI-ALP*

(*c*) Avro 643 Mk. II Cadet

Constructor's No. and Registration		*C. of A. Issued*	*Details*
849	*G-ADJT*	14. 9.35	Sold in France 3.38 as *F-AQMX*
867	*PP-TAF**	nil	To José Daniel de Camargo, Brazil 11.35
920	*VR-RAK*	16. 3.36	Perak Flying Club Ltd.
921	*VR-RAL*	11. 3.36	Perak Flying Club Ltd.

*Duplicating registration of Avro 671 Cierva C.30A c/n 738.

Air Service Training Ltd. fleet: c/n 870–889, *G-ADTF–'TZ*; 922, 926, 949, *G-AEAR, 'IR, 'NL.*

(*d*) Avro 643 Mk. II Cadet (R.A.A.F.)

Constructor's Number	Aircraft markings
850–861	*A6-1* to *A6-12* (Cs. of A. issued 29.10.35 to 2.1.36) Civil conversions: 851 *VH-APV*; 854 *VH-AEG*; 857 *VH-AEJ*; 859–861 *VH-AMM, 'FW, 'FX*
986–995	*A6-13* to *A6-22* (Cs. of A. issued 15.12.37 to 3.2.38) Civil conversions: 990 *VH-AGH*; 991 *VH-AEH/VH-PRV*; 994 *VH-AFZ*
1058–1069	*A6-23* to *A6-34* (Cs. of A. issued 18.11.38 to 28.2.39) Civil conversions: 1058 *VH-AHH*; 1060 *VH-AEI/VH-PRU*; 1062 *VH-AHW*; 1063 *VH-APW*; 1066–1069 *VH-AFY, 'GC/VH-PRT, 'EL, VH-BJB**

*Fitted with Wackett Trainer sliding canopy.



Avro 643 Mk. II Cadet *VH-AFY* at Archerfield, Brisbane in January 1964, equipped for crop spraying as a single seater with trailing edge nozzles and 220 h.p. Jacobs R-755 engine. (*Photo: J. Hopton.*)



A.14, first Avro 636 for the Irish Army Air Corps.

Avro 636

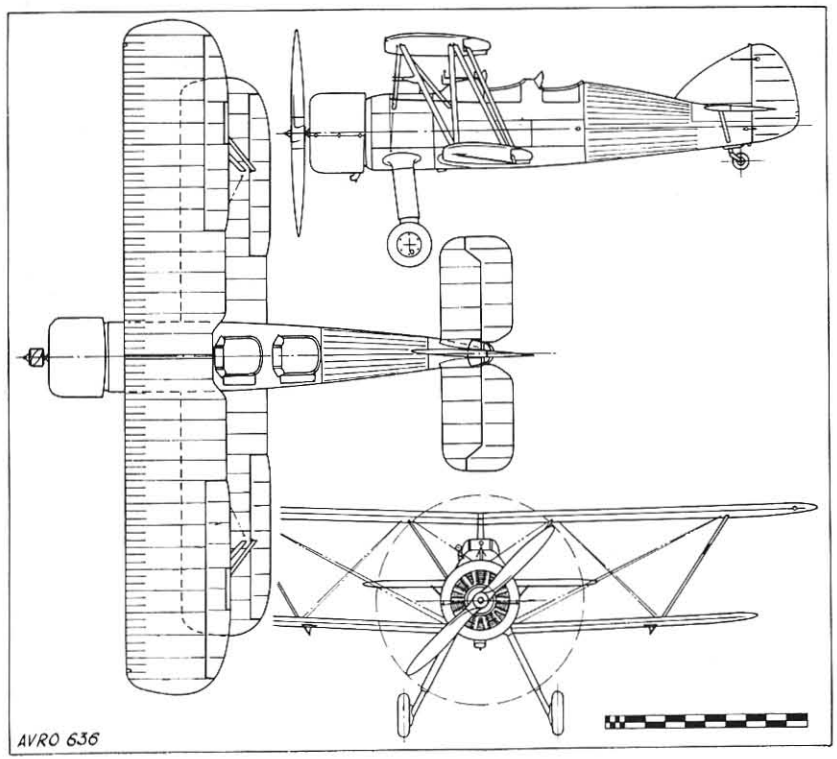
The unnamed Avro 636 two seat fighter trainer, designed by Roy Chadwick in November 1934 and built in 1935, was not only the ultimate development of the Avro 621 theme, but also the only Avro aeroplane to show visible evidence of the firm's absorption into the Hawker Siddeley Group. Its fuselage structure was of welded steel tube and all fuel and oil lines, control rods and cables, were accessible by removing curved, fabric covered outer panels in true Tutor tradition. The fabric covered metal mainplanes and tailplane, however, were constructed by the Armstrong Whitworth riveted system, and the aircraft was almost identical in size, weight and external appearance to the Armstrong Whitworth A.W. 35 Scimitar single seat fighter.

The Avro 636 was a heavily staggered, single bay biplane with wings and tail unit built up from spars and ribs of high tensile steel strip and equipped with Frise-type ailerons on top and bottom wings. Powered by a 420 h.p. Armstrong Siddeley Jaguar IV, the machine was designed to reproduce the flying characteristics of contemporary single seat fighters and thus be suitable for fighter pilot tactical training, or for dual or solo advanced aerobatics. With the rear seat faired over, it could be used purely as a fighter, for which purpose it was equipped with two forward firing Vickers guns projecting from the hump which raised the cockpits above the level of the engine cowling. In this role it was, like the Scimitar, powered by an Armstrong Siddeley Panther radial in an Armstrong Whitworth two-piece, long chord cowling and designated Avro 636A.

It was one of the cleanest biplanes ever built. Fuel was carried in the front fuselage to leave the upper wing free of all projections, while the undercarriage—revolutionary for those days— was equipped with low pressure airwheels (with neatly faired Dunlop brake drums), mounted on cantilever

oleo legs attached to the bottom longeron and taken upwards inside the fuselage to meet at the mid point of a cross strut between the top longerons. This also formed an anchorage for the engine mounting.

Construction of the first Avro 636, laid down as a civil demonstrator and registered *G-ADHP* in May 1935, was abandoned, but as in the case of the Avro 631 Cadet, the first (and in this instance, the only) customer was the Irish Army Air Corps, purchaser of four machines in December 1934. These were powered by four old 460 h.p. Armstrong Siddeley Jaguar VIC unsupercharged engines originally procured in 1930 for installation in four Vickers Vespa IV Army Co-operation biplanes supplied to the Free State in March of that year. Despite the reservation of type number Avro 667 for the Jaguar VIC machine, it was always referred to as the Avro 636 but performance was rather less dramatic than it would have been with the Panther's extra 180 h.p. Nevertheless it was a remarkable aeroplane, having a top speed of 175 m.p.h. and controls which were light, positive and well harmonised throughout a wide speed range. The four Irish machines were delivered to Baldonnel in August 1935 and remained in service there for several years, at least two (including *15*) taking part in air firing exercises at Gormanston, Co. Meath in 1938.



SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester

Power Plants:
(Avro 636) One 420 h.p. Armstrong Siddeley Jaguar IV
(Avro 636A) One 680 h.p. Armstrong Siddeley Panther XI
(Avro 667) One 460 h.p. Armstrong Siddeley Jaguar VIC

Dimensions:
Span (upper) 33 ft. 0 in. (lower) 27 ft. 3 in.
Length 27 ft. 6 in. Height 11 ft. 7 in.
Wing area 261 sq. ft.

Weights:
(Avro 636A) Tare weight 2,970 lb. All-up weight 3,924 lb.
(Avro 667) Tare weight 2,766 lb. All-up weight 3,721 lb.

Performance:
(Avro 636A) Maximum speed 230 m.p.h.
Cruising speed 195 m.p.h.
Initial climb 2,000 ft./min.
Ceiling 32,000 ft. Range 290 miles
(Avro 667) Maximum speed 175 m.p.h.
Initial climb 1,200 ft./min.
Ceiling 18,000 ft.

Production:
(*a*) Avro 636—one civil demonstrator *G-ADHP*, c/n 821, registered to A. V. Roe and Co. Ltd. 27.5.35, construction abandoned, s.o.r. 12.36
(*b*) Avro 667—four fighter trainers for the Irish Army Air Corps July 1935, *A.14* to *A.17*, c/n 863–866 (prefix *A* dropped by 1938)



Avro 638 Club Cadet *G-ACHO* of the Airwork School of Flying, over Heston in 1933. (*'The Aeroplane' Photo.*)

Avro 638 Club Cadet and Variants

A version of the Cadet for clubs and private owners, introduced in 1933, was known as the Avro 638 Club Cadet. Its structure was identical with that of the Avro 631 but the stagger was greatly reduced so that the wings could fold for economy in hangar space. The prototype, *G-ACAY*, first flew at Woodford in May 1933 but only 15 others were built, all for the home market, and the first production machine *G-ACGY* went to the Lancashire Aero Club which was already operating two Avro 631s. Three others, *G-ACHN-'HP*, delivered from Woodford to Airwork Ltd. at Heston in formation on June 21, 1933 were joined a month later by *G-ACTX* and *'TZ*. The five green and white Club Cadets served the Airwork School and its successor, the Airwork Flying Club Ltd., for many years during which they were fitted with 130 h.p. de Havilland Gipsy Major in-line engines. Being of smaller frontal area than the seven cylinder Armstrong Siddeley Genet Major Is fitted originally, the Gipsy reduced fuel consumption.

A few Club Cadets were used privately, notably *G-ACHW* by S. P. Tyzack; *'NY* by Lord Londonderry; and *G-ADBC* at Manorbier by the Earl of Essex. The majority of these soon gravitated to the clubs, however, the largest fleet being that of the Southend Flying Club which, at the outbreak of war in 1939, owned *G-ACAY*, *'HW*, *'JZ*, *'TB* and *'TX*. Together with some private aircraft they were removed in 1940 to the local Middleton Garage where tail units and other projecting parts taking too much space were simply sawn off. In 1935 the Southend club also acquired the Club Cadet Special *G-ACIL*, built originally to the order of prominent Renfrew pilots, Douglas and the Hon. Mrs. Margaret Fairweather, whose names later became legendary in Air Transport Auxiliary. *G-ACIL*, fitted with a 140



Airwork's Club Cadet *G-ACHN* after conversion to D.H. Gipsy Major engine, 1936. (*'The Aeroplane' Photo.*)



G-ACGA, the only Avro 639 Cabin Cadet completed. (*'Flight' Photo 10218S.*)

h.p. Cirrus Hermes IVA and most powerful Club Cadet, first flew at Woodford with Class B marking *K-11*. It was destroyed in a serious accident soon after it went to Southend.

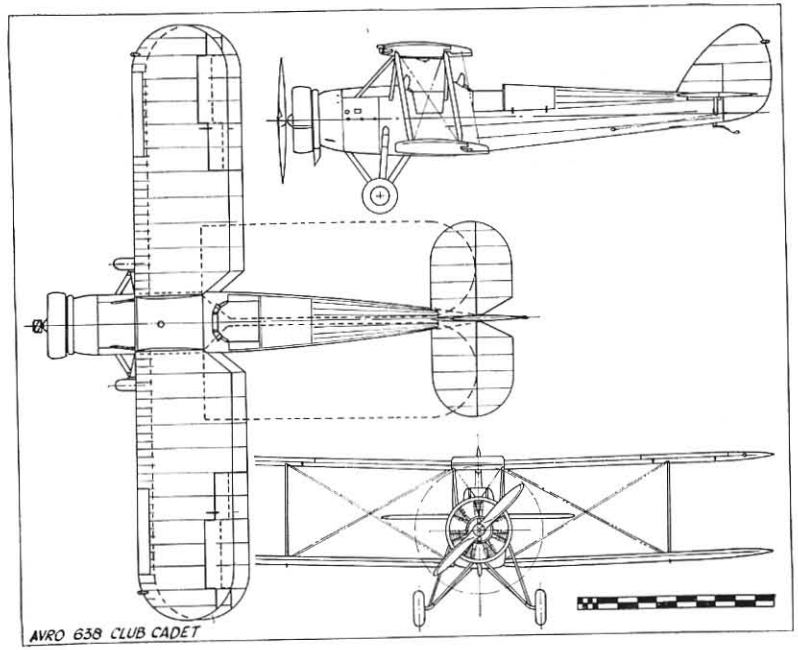
An enclosed version designated Avro 639 Cabin Cadet was built on the same lines as the open model but the fuselage filled the whole mainplane gap and the 28 gallon fuel tank, normally carried in the centre section, was repositioned under the floor. It was flown at Woodford and Hamble under B conditions as *K-14* and later as *G-ACGA* during 1933–34 but did not go into production.

A final variant, the Avro 640 Cadet three seater, was also fitted with folding wings, but whereas the Avro 639 seated three with pilot in front, the 640 had the front fuselage widened to seat two passengers side-by-side in an open cockpit in front of the pilot for joyriding work. The first four Avro 640s were

powered by 140 h.p. Cirrus Hermes IVs and slightly antedated the Club Cadet. They were delivered to the Scottish Motor Traction Co. Ltd. at Renfrew in April–May 1933 for pleasure flying in the Highlands and Islands.

Only nine Avro 640s were constructed and the remaining five, powered by 135 h.p. seven cylinder Genet Major Is, were not easily distinguishable from Club Cadets. *G-ACFX*, first with Genet Major I, was delivered to Midland and Scottish Air Ferries Ltd. in June 1933 but was later sold abroad. The remaining four comprised *G-ACFX*, Heston-based demonstrator of Cadet distributors Henlys (1928) Ltd.; and *G-ACLU*, *'PB* and *'OZ* for Sir Alan Cobham's National Aviation Day Displays. One red, one white and one blue, they were used for formation passenger flights and for dropping parachutists. When the Scottish Motor Traction Co. Ltd. ceased flying operations in 1935, *G-ACFU* was sold to Tom Campbell Black and went on tour with C. W. A. Scott's Flying Display, while the other three joined the ex-Cobham *'PB* with Utility Airways Ltd. They gave seasonal pleasure flights in the Liverpool, Manchester, Southport and Blackpool area until 1939, when they were stored with several other machines under the grandstand at Hooton Park Racecourse, and were lost when it was destroyed by fire on July 8, 1940.

No Avro 640s survived the war and the only Club Cadet to do so in airworthy condition was the former Airwork *G-ACHP*. Its four stablemates *'HO*, *'NY*, *'TZ* and *'ZS* were shipped abroad in 1941 and remain untraced, but *'HP* was used by Saunders-Roe Ltd. throughout the war for





G-ACFH, the first Avro 640 Cadet three seater, flying in Scottish Motor Traction Co. colours. (*'Flight' Photo.*)

communicating between their Cowes and Eastleigh factories. For this purpose it was impressed by the R.A.F. and camouflaged as *HM570*. After overhaul by Saunders-Roe Ltd. in June 1946 it flew for ten more years, mainly as mount of the Vintage Aeroplane Club, until wrecked at Denham on January 1, 1956.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Middleton, Manchester

Power Plants: (Avro 638) One 130 h.p. de Havilland Gipsy Major I
One 135 h.p. Armstrong Siddeley Genet Major I
One 140 h.p. Cirrus Hermes IVA
(Avro 639) One 135 h.p. Armstrong Siddeley Genet Major I
(Avro 640) One 135 h.p. Armstrong Siddeley Genet Major I
One 140 h.p. Cirrus Hermes IV

Dimensions, Weights and Performances:

	Avro 638	Avro 639	Avro 640
Span	30 ft. 2 in.	30 ft. 2 in.	30 ft. 0 in.
Length	24 ft. 9 in.	24 ft. 9 in.	24 ft. 9 in.
Height	8 ft. 9 in.	8 ft. 9 in.	8 ft. 9 in.
Wing area	262 sq. ft.	262 sq. ft.	261¼ sq ft.
Tare weight	1,244 lb.	—	1,140 lb.
All-up weight	2,000 lb.	—	1,855 lb.
Maximum speed	115 m.p.h.	—	110 m.p.h.
Cruising speed	100 m.p.h.	—	95 m.p.h.
Initial climb	—	—	700 ft./min.
Ceiling	—	—	13,500 ft.
Range	325 miles	—	325 miles

Production:

(*a*) Avro 638 Club Cadet

Constructor's No. and Registration		*C. of A. Issued*	*Details*
626	*G-ACAY*	2. 6.33	Southend Flying Club, broken up 1940
650	*G-ACGY*	6. 6.33	Lancashire Aero Club, sold abroad 2.39
651	*G-ACHN**	22. 6.33	Airwork Ltd., crashed during the war
652	*G-ACHO**	26. 6.33	Airwork Ltd., shipped abroad 6.41
653	*G-ACHP**	26. 6.33	Airwork Ltd., impressed 7.42 as *HM570* for Saro; to Vintage Aeroplane Club 1952; crashed at Denham 1.1.56
654	*G-ACHW*	3. 8.33	Southend Flying Club, broken up 1940
655	*G-ACHY*	nil	Construction abandoned
661	*G-ACIL***	18. 7.33	Initially *K-11*; Southend Flying Club, crashed at Thundersley, Essex, 22.12.35
667	*G-ACJZ*	16. 9.33	Southend Flying Club, broken up 1940
686	*G-ACNY*	24. 3.34	Airwork Ltd., shipped abroad 6.41
704	*G-ACTB*	1. 6.34	Southend Flying Club, broken up 1940
718	*G-ACTX*	27. 6.34	
719	*G-ACTY*	nil	Construction abandoned
720	*G-ACTZ**	14. 7.34	Airwork Ltd., shipped abroad 2.41
797	*G-ACZS*	8. 2.35	Airwork Ltd., shipped abroad 6.41
807	*G-ADBC*	7. 2.35	Sold in France 4.37 as *F-AQCJ*
816	*G-ADEH*	10. 4.35	York Aviation and Country Club Ltd., scrapped at Tollerton 1950

*Re-engined with Gipsy Major I circa 12.36. **Cirrus Hermes IVA.

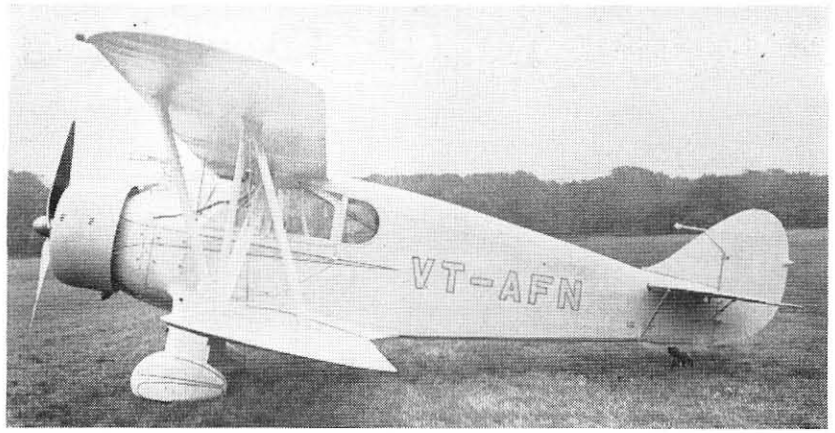
(*b*) Avro 639 Cabin Cadet

639	*G-ACGA*	nil	Also flown as *K-14*, scrapped 1936

(*c*) Avro 640 Cadet three-seater

640	*G-ACFH**	28. 4.33	Scottish Motor Traction Co. Ltd.; to Utility Airways Ltd. 7.35, burned at Hooton 8.7.40
644	*G-ACFS**	18. 5.33	
645	*G-ACFT**	18. 5.33	
646	*G-ACFU**	18. 5.33	Initially S.M.T. Co. Ltd.; to T. Campbell Black 7.35, crashed at Leigh, Lancs. 2.8.37
647	*G-ACFX*	23. 6.33	Midland and Scottish Air Ferries Ltd.; to the Perak Flying Club 11.36 as *VR-RAJ*
666	*G-ACJX*	14.10.33	Henlys' demonstrator, dismantled 11.34
679	*G-ACLU*	11. 4.34	National Aviation Day; sold abroad 4.39
696	*G-ACPB*	11. 4.34	National Aviation Day; to Utility Airways Ltd. 7.35, burned at Hooton 8.7.40
697	*G-ACOZ*	11. 4.34	National Aviation Day; scrapped 1941

*140 h.p. Cirrus Hermes IV.



The Maharajah of Vizianagram's Avro 641 Commodore *VT-AFN*

Avro 641 Commodore

Experience gained in building and flying the little three seat Avro 639 Cabin Cadet led in 1934 to the construction of a larger version accommodating up to five persons. Two pilots sat in front with a central control column having swing-over spectacle-type aileron control so that the machine could be flown from either seat, and two passengers (or three with less luggage) sat in the rear. Known as the Avro 641 Commodore, it was a direct descendant of the well-tried Tutor and was of the same form of metal construction. The usual system of heavily staggered mainplanes was employed together with rigid N-type interplane struts, but Frise-type ailerons were used, and then only on the lower wing.

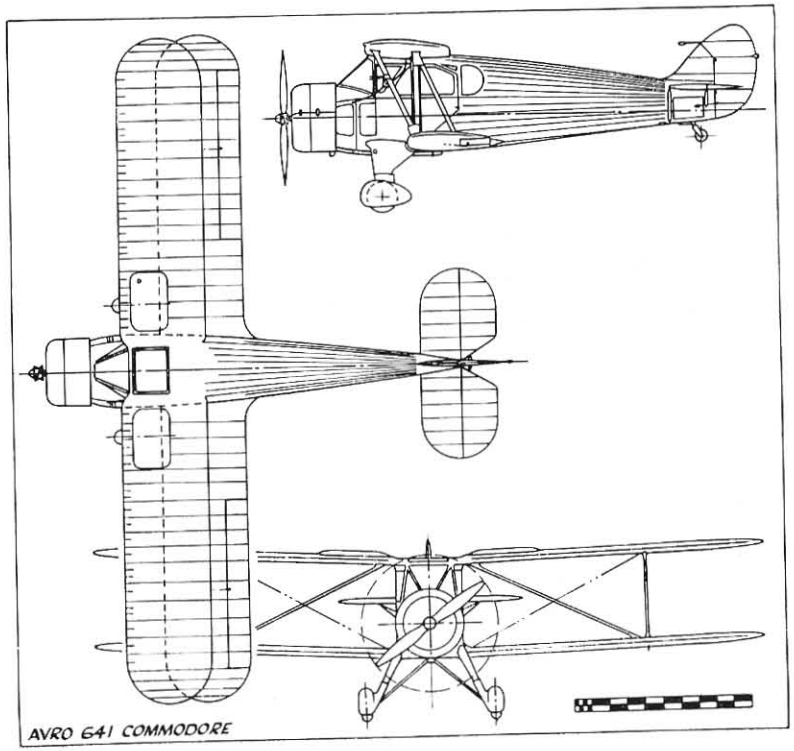
Powered by an electrically started 240 h.p. Armstrong Siddeley Lynx IVC driving a Fairey Reed metal airscrew, the Commodore was equally suitable for taxi work or as a luxury class private aeroplane. Fuel for a useful range of 500 miles was carried in two 25 gallon tanks in the upper wing roots so that smoking could be permitted in the cabin. America had already established a lead with this class of tourer and a number of U.S. cabin types had already been seen in the U.K., notably *G-ACGJ*, Lady Hay Drummond Hay's Waco UIC which arrived in June 1933. Due to its Tutorial origins the Commodore bore a striking, but entirely coincidental, resemblance to the Waco although the American machine probably inspired the Avro's newer features —the stout tubular metal strut in place of landing wires; faired, spatted undercarriage; and long chord engine cowling.

Businesslike in appearance and with a robust performance, the Commodore was years before its time and so far ahead of the demand that only six were sold. These were built in the Avro works at Failsworth, Manchester,

and the silver prototype, *G-ACNT*, was delivered to private owner W. Westhead at Woodford on May 24, 1934. Later in the day he flew it south to Heston, social focus of private flying in those days, and destined to be the home base of all five British registered Commodores. Capt. the Earl of Amherst's red and grey *'RX*, which joined the prototype a few weeks later, was used later for taxi work by the British Air Navigation Co. Ltd. (BANCO). Then followed the green and white *G-ACUA* for Airwork Ltd.; blue and silver *'UG* for Maj. J. E. Durrant Shaw; and finally *'ZB* for Henlys (1928) Ltd. who were to handle Commodore sales.

Only one more Commodore was, in fact, completed; this was *VT-AFN* sold in India to the Maharajah of Vizianagram in October 1934. The remaining half-finished airframes were broken up in the works, a fate which also overtook *'FN* which had proved unsuitable for operation in India and returned to England in 1935. After a year in private hands the prototype was repurchased by the manufacturers and redoped in red and grey for use as a 'hack'. It was dismantled at Woodford in October 1939 and there seems little doubt that, after storage during the Second World War, it was broken up along with the company's Avro 626 *G-ACFW* and several Cadets in 1951.

In June 1934 a scheme was considered under type number Avro 665



whereby a Commodore fuselage with Lynx IVC engine was to be equipped with a three bladed rotor and flown as the four seat Cierva C.33 autogiro, but the aircraft was not completed.

In 1935 Airwork Ltd. sold their Commodore *G-ACUA* to an Egyptian private owner at Almaza, Cairo, where it was joined a few months later by BANCO's *'RX*, which had been sold to V. H. Tait, an R.A.F. officer serving in Egypt. This too passed into Egyptian hands in 1936 but soon afterwards both Commodores were taken over by the Egyptian Army Air Force which had ample stocks of interchangeable Avro 626 spares and was well able to maintain them for communications work.

In England, Maj. Shaw's private *'UG* was based at Kirbymoorside, Yorks., in connection with his interest in Slingsby Sailplanes Ltd., while from March 1936 *'ZB* operated from Whitley Aerodrome, Coventry, as a liaison 'hack' between the Armstrong Whitworth factory and R.A.F. squadrons working up on the new A. W. Whitley bombers. At the outbreak of war both Commodores were impressed and camouflaged, *'ZB* being posted for service with No. 51 O.T.U., Cranfield, until struck off charge in 1942. *G-ACUG* on the other hand was issued to Air Transport Auxiliary for training duties at White Waltham where it stalled in a cross wind on the approach with fatal results for the pilot in the summer of 1941.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Failsworth, Manchester; and Woodford Aerodrome, Cheshire

Power Plant: One 240 h.p. Armstrong Siddeley Lynx IVC

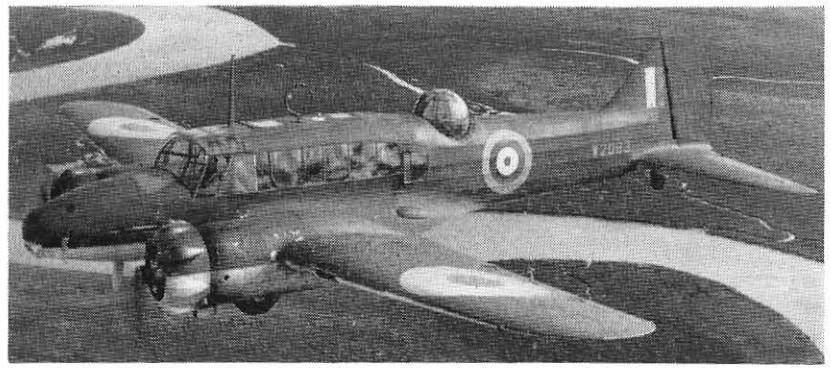
Dimensions: Span 37 ft. 4 in. Length 27 ft. 3 in.
Height 10 ft. 0 in. Wing area 307 sq. ft.

Weights: Tare weight 2,237 lb. All-up weight 3,500 lb.

Performance: Maximum speed 130 m.p.h. Cruising speed 110 m.p.h.
Initial climb 700 ft./min. Ceiling 11,500 ft.
Range 500 miles

Production:

Constructor's No. and Registration		*C. of A. Issued*	*Details*
691	*G-ACNT*	18. 5.34	Prototype, dismantled at Woodford 13.10.39, believed broken up at Woodford 1950
700	*G-ACRX*	3. 7.34	To Egypt 1936 as *SU-AAS*, later to the Egyptian Army Air Force
721	*G-ACUA*	11. 8.34	To Egypt 1936 as *SU-AAU*, later to the Egyptian Army Air Force
722	*G-ACUG*	28. 9.34	Impressed 15.2.41 as *DJ710*; to H.Q. Training Ferry Pilots' Pool, crashed at White Waltham 10.8.41
729	*G-ACZB*	24. 4.35	Impressed 27.8.41 as *HH979*; initially to R.A.F., Cranfield; 3.42 to No. 6 M.U. Brize Norton; 6.42 to No. 51 O.T.U., Cranfield; s.o.c. 17.8.42
759	*VT-AFN*	16.10.34	Maharajah of Vizianagram, broken up at Woodford 1935



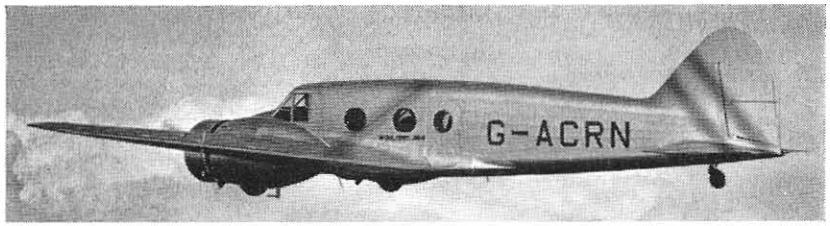
Avro 652A Anson I *W2083* flying in wartime colours in Australia. (*Department of Air Photo.*)

Avro 652A Anson Mks. I–X

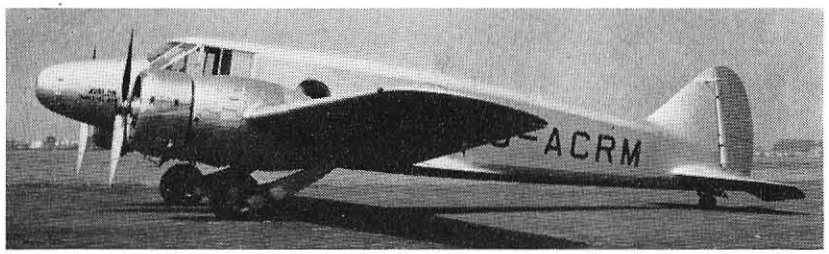
In the early thirties American high performance aeroplanes set a fashion which quickly spread to Europe, where the new twin-engined, low wing formula with retractable undercarriage was rapidly adopted by several manufacturers. The significance of these developments was not lost on G. E. Woods-Humphery, managing director of Imperial Airways Ltd., and on May 18, 1933 he submitted a specification to Sir John Siddeley of the Avro company for a small, but fast, long range charter aircraft of this type. Enthusiasm at Manchester was such that by August 1933 a design study had been prepared and approved for a four passenger aircraft powered by two Armstrong Siddeley Cheetah radials, cruising at 150 m.p.h. over a still air range of 600 miles.

So was born the Avro 652, Roy Chadwick's brilliant adaptation of the Avro-Fokker airframe in which the well tried, one-piece wooden mainplane was merely moved from the high to the low wing position. Its welded steel tube fuselage was rounded out by fabric over wooden formers, and the undercarriage (retracted by 140 turns of a chain driven, low pitch screw gear) moved forwards and upwards into streamlined engine nacelles. The 270 h.p. Cheetah V engines were housed in smooth, long chord cowlings and drove Fairey Reed metal airscrews. Each of the four passengers had an individual circular window and two crew sat side by side with dual control behind a gently sloping, five panel windscreen.

While the Avro 652 was in the design stage, the Air Ministry invited the Avro company to tender for a twin engined coastal patrol landplane for the large expansion programme made necessary by events in Europe. Their specification resembled that of the Imperial Airways machine so closely that



"Ava", second of Imperial Airways' Avro 652 charter aircraft in original form with horn balanced rudder. (*'The Aeroplane' Photo.*)



Imperial Airways' Avro 652 "Avalon" with mass balanced rudder fitted. (*B.O.A.C. Photo.*)

it was a comparatively simple matter to prepare designs for an Avro 652A military version. These were submitted to the Air Ministry on May 19, 1934.

Powered by 295 h.p. Cheetah VIs in helmeted cowlings, the Avro 652A had an estimated cruising range of 600 miles at 160 m.p.h. and was offered with a gunner's position (with single Lewis) in the roof above the main spar; or a hand operated turret (of the type used on the A. W. Whitley) aft of the wings. A bomb load of 360 lb. was carried in the centre section and the pilot had a single Vickers gun on the port side, but the Avro 652A was otherwise similar to the civil version except that the windows were now square and the entry door was in the starboard side. Competition within the aircraft industry was fierce, but prototype orders were placed only with A. V. Roe and Co. Ltd. and the de Havilland Aircraft Co. Ltd. for one Avro 652A (with turret) and one D.H.89M to be delivered in March 1935.

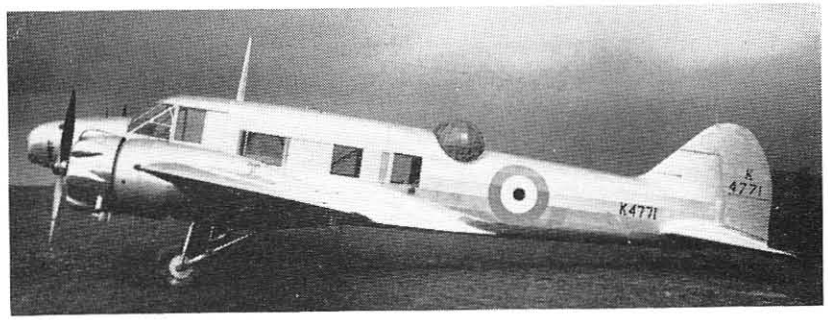
When the first Avro 652 for Imperial Airways Ltd. was flown for the first time at Woodford on January 7, 1935 by F. B. Tomkins, few adjustments were found necessary and its handling qualities were in the true Avro tradition, surpassing even those of the firm's classic biplanes. Both Avro 652s, *G-ACRM* "Avalon" and *'RN* "Avatar" (almost immediately changed to "Ava") were delivered at Croydon on March 11, 1935 and the military Avro 652A prototype *K4771* first flew on March 24 piloted by S. A. 'Bill' Thorn. Service trials conducted by the Coast Defence Development Unit at Gosport in competition with the D.H.89M *K4772* between May 11 and 17 favoured the Avro 652A, and earned it a place in the New Types Park at the Hendon

R.A.F. Display on June 29, 1935. Further Martlesham trials, however, showed that a 25% increase in tailplane span and a reduction in elevator area was desirable.

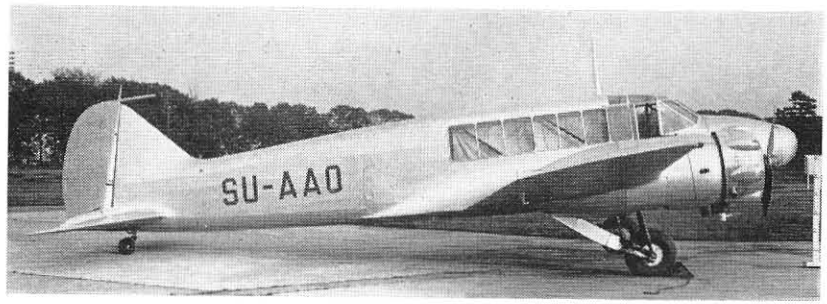
An alternative design—the Avro 664—was then dropped, and following a decision made on May 25 to adopt the Avro 652A as standard equipment, Air Ministry Specification 18/35 was written round it and a contract placed for 174 aircraft. The production prototype *K6152*, first flown at Woodford by Geoffrey Tyson on December 31, 1935, was thereupon given the Service name Anson Mk. I. Typical of the thousands of Ansons which were to fly millions of miles during the Second World War, *K6152* had a higher continuous line of cabin windows giving uninterrupted all-round view, a further increase in tailplane span and 350 h.p. Cheetah IX engines in seven-lobed NACA cowlings. Armament remained the same as on *K4771*. The rudder, horn balanced on *K4771* and the two civil machines, was now mass balanced and this modification was incorporated in all three earlier machines in September 1935. After the first few aircraft, wing trailing edges were made detachable at the rear spar to simplify transportation.

In Imperial Airways service the Avro 652 cruised at the unprecedented speed of 165 m.p.h. and flew the long Croydon–Brindisi route with monotonous regularity for several years until sold to Air Service Training Ltd. as navigation trainers. Their work continued at Hamble with No. 11 Air Observer's Navigation School until impressed in February 1941 for R.A.F. service with No. 1 School of Photography, Farnborough. Five months later they were handed over to the Royal Navy and ended their days with No. 811 Squadron, Lee-on-Solent.

To fulfil an R.A.A.F. order for 12 Ansons, *K6212–K6223* were deleted from the R.A.F. contract, reserialled *A4-1* to *A4-12* and delivered in Melbourne by s.s. *Orani* on November 19, 1936. The first was test flown by Wing Cdr. A. W. Murphy at Laverton on December 2 as a prelude to their issue to Nos. 2, 3 and 5 (General Reconnaissance) Squadrons at Laverton, V., and Richmond, N.S.W. The Australian order was later increased to 48, the



K4771, the Avro 652A prototype. (*Crown Copyright Reserved.*)



The Avro 652 Mk. II *SU-AAO* built for the Egyptian Government.

last ten of which were the first Ansons fitted with Sperry blind flying panels. In England the first Ansons (*K6153–K6162*) were delivered to No. 48 Squadron, Manston, in February 1936 and commissioned on March 6, a date historically important as that on which the R.A.F. put its first monoplane and first retractable undercarriage into squadron service. Armament included two 100 lb. and four 20 lb. bombs, or flares and smoke floats.

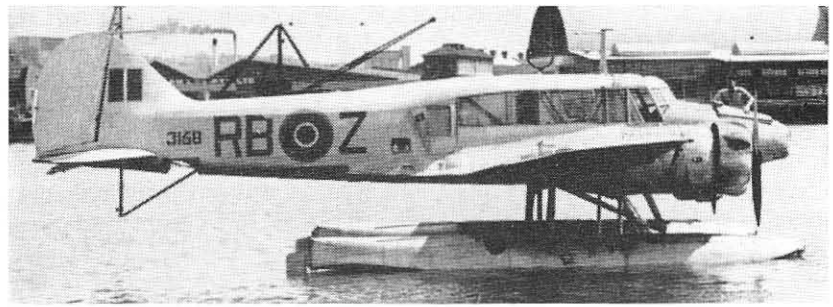
Later in 1936 two further contracts were placed for a total of 135 aircraft during the construction of which metal framed ailerons and steeper windscreens with opening direct vision panels were introduced and (commencing *K8720*) hydraulically operated Schrenk flaps were fitted to steepen the glide. Diversions from this batch were three to the Finnish Air Force and one to the Estonian Air Force. In October 1936 a special Anson *SU-AAO* was cleared for a take-off weight of 8,000 lb. and flown to Egypt in civil marks so that the Egyptian Army Air Force might test its suitability for a proposed Bomber Transport Squadron. The entry door was certainly on the port side but its official designation Avro 652 Mk. II was scarcely justifiable in view of its almost complete external similarity to an Anson I. Also additional to R.A.F. production were two more Anson Is (serials *21* and *22*) for the Irish Army Air Corps in May 1938. War cut short an order for 25 placed by the Turkish Government and only six were delivered, but 12 were flown out to the Greek Air Force in British civil marks in June 1939. Many of these were captured by the Germans when the British withdrew from Greece on April 4, 1941, but a few managed to escape to Egypt to form the nucleus of a Light Bomber Squadron. A number of R.A.F. Anson Is transferred to the Royal Iraqi Air Force 1938–39 remained in service until destroyed in the uprising of May 2, 1941.

Anson I deliveries to the R.A.F. proceeded rapidly and five complete squadrons (Nos. 206, 220, 224, 233 and 269) flew past in mass formation at the Hendon R.A.F. Display of June 26, 1937. For $3\frac{1}{2}$ years they formed the backbone of Coastal Command and although already obsolescent when war was declared, adopted an unexpectedly warlike attitude, first evinced by an Anson I of No. 500 Sqn., Detling, which bombed a German U-boat on

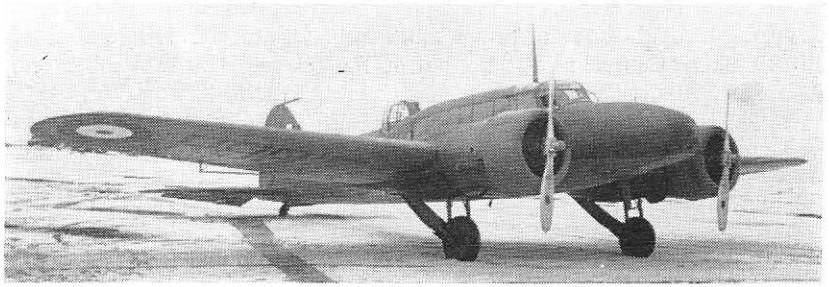
September 5, 1939. Ansons of this squadron carried two additional machine guns firing through the side windows and the C.O.'s machine had a 20 mm. anti-submarine cannon in the bottom of the fuselage. In September one of No. 269 Squadron's Ansons shot down a Dornier Do 18 flying boat and in June 1940 three Ansons on patrol over the English Channel not only survived an attack by three Me 109s but by surreptitiously throttling back, succeeded in destroying two and damaging the third as they overshot. In July 1940 an Me 110 fighter, an He 115 seaplane and an He 111 bomber were also shot down by Ansons.

When the Lockheed Hudsons arrived Ansons were withdrawn from front line service although a number were fitted with early ASV radar and remained with Air Sea Rescue Squadrons until 1942. The majority were relegated to instructional duties which they performed with distinction at Flying Training, Navigation and Air Gunnery Schools until the end of the war. Those fitted with dual control for pilots' twin conversions generally had the A.W. hand operated turret removed, but it was retained as an astrodome on flying classroom Ansons used by W/T operators and navigators until the aircraft next came up for major overhaul. The balance of the 2,476 Ansons Is built under six Air Ministry contracts placed 1937–40 were completed as turretless trainers. Later when the Blackburn Bothas and other types used by the Air Gunnery Schools were no longer considered satisfactory, they were replaced by 313 Anson Is specially built with Bristol B.1 Mk. VI turrets, hydraulically operated by electric motors under the floor. Training Ansons had twin landing lights in the leading edge of the mainplane in place of the single unit in the nose and a number were loaned to the U.S.A.A.F. in England for communications duties, e.g. *AX623* at Steeple Morden.

Supplementary orders were placed in 1939 for 1,500 more Anson Is (later increased by a further 800), 40 of which were loaned to Australia for use by Nos. 2, 4 and 6 (Bomber) Squadrons R.A.A.F., while others were supplied to the S.A.A.F. under Specification 33/35. In 1940 they replaced Ju 86s on shipping patrol work off East Africa with No. 60 Sqn. and on anti-submarine



The South African Air Force Anson I seamanship trainer *3158* at Congella, Durban, circa 1942.



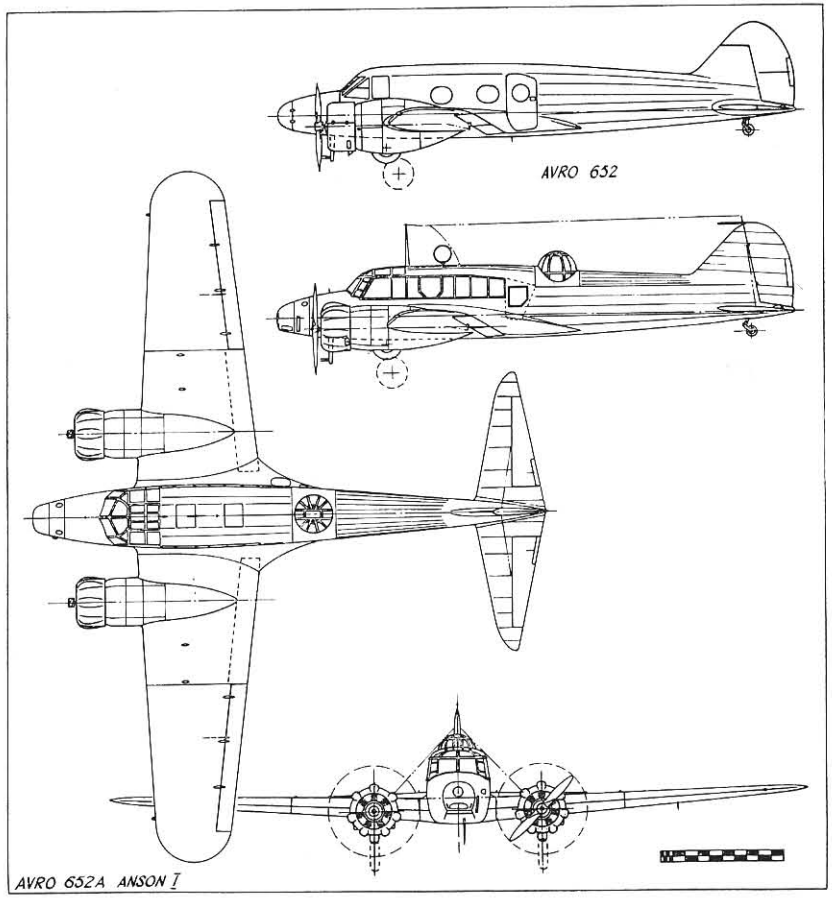
The Anson IV prototype *R9816* with Wright Whirlwind engines and variable pitch airscrews, February 1942. (*Crown Copyright Reserved.*)

work off the Cape with Nos. 31, 32 and 33 Flights, S.A.A.F. One, serial *3158*, was fitted with floats as a non-flying seamanship trainer for Sunderland squadrons using Congella flying boat base, Durban. Dutch air crews who fled to the U.K. in 1940 were also given Ansons with which to form No. 320 Sqn., Coastal Command, and after the war were presented with surplus machines to take home for the newly unified Royal Netherlands Air Force.

Ansons were delivered in numbers to schools of the Commonwealth Air Training Plan in Canada, Australia and elsewhere, and by January 20, 1945 shipments to Australia had reached a figure variously given as 1,028 and 1,034 Ansons (including the original 48). About 450 were in long term storage in 1948, and *W2599* was still preserved in full training yellow by Marshall Airways Ltd. at Bankstown, Sydney, as late as 1963. Many were lost at sea, as for example *R9712*, *AW620* and *AX302* sunk during shipment to Canada, Australia and South Africa respectively. Large numbers of elderly squadron Ansons, as well as new aircraft in the *N*, *R* and *W* series were sent to Canada but U-boat activity and the shortage of Cheetah IX motors led to the construction of complete Ansons in that Dominion. They were fitted with 330 h.p. Jacobs L6MB engines under designation Anson Mk. II, but as an interim measure some British-built aircraft were Jacobs powered to become Anson Mk. IIIs, and 223 airframes were built specially for shipment to Canada to be fitted with 300 h.p. Wright Whirlwind R-760-E1 radials. These were known as Anson Mk. IVs, the trial installation for which was made in England in *R9816*.

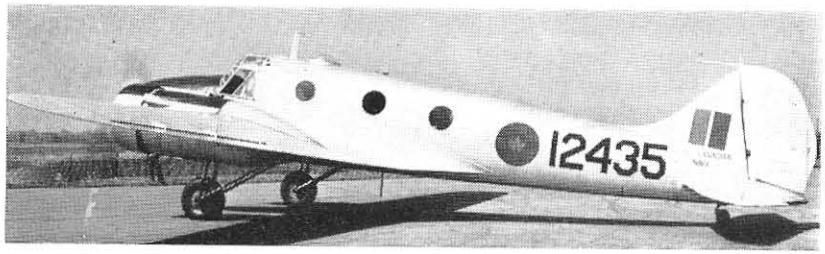
The all-Canadian Anson Mk. II had revised windows and a Vidal plastic-bonded nose, while both the Anson Mks. II and III had parallel undercarriage radius rods in place of the old single fork type, as well as Dowty hydraulic retraction and flap systems. The prototype Anson II, *7069*, adapted from an Anson I by Federal Aircraft Ltd. and first flown on August 21, 1941, was the first of 1,050 built by six sub-contractors. Fifty were supplied to the U.S.A.A.F. in 1943 for advanced crew training as the Model AT-20 with 330 h.p. Jacobs R-915-7 engines.

To husband stocks of steel it was decided to abandon Avro-Fokker tradition and build an all-wood version with the fuselage entirely of Vidal moulded plywood. Trainees were increased to five and 'greenhouse' windows replaced by three circular portholes. A prototype fuselage made by Vidal at Bristol, Mass., and equipped with major components from Anson Mk. I *N9943* and Anson Mk. IV *6013*, flew in 1942 as the first Anson Mk. V *8649X*. Production of 1,070 turretless navigation trainers began immediately at three aircraft plants, and a single Anson Mk. VI gunnery trainer *13881* with Bristol B.1 Mk. VI turret was also built. Both marks were powered by the 450 h.p. Pratt and Whitney Wasp Junior R985-AN12B or AN14B radials driving Hamilton or Hoover constant speed airscrews. Marks VII, VIII and IX were reserved for later Canadian variants which did not materialise. The Anson Mk. Vs remained in R.C.A.F. and Royal Canadian Navy service





11561, an Anson II of the S.B.A. Training Flight, No. 33 S.F.T.S., Carberry, Manitoba, Canada. (*Photo courtesy of J. M. Bruce.*)



Royal Canadian Navy Anson V *12435*.

until the late '50s when the last four flew from Uplands to Trenton, three for civilian disposal and *12518* for preservation by the R.C.A.F.

Production of 7,195 Anson Mk. Is ordered from A. V. Roe and Co. Ltd. was speeded by the establishment of a shadow factory at Yeadon, Yorks., where the output reached 130 aircraft a week in 1943–44. They included a batch of 20 urgently needed by the R.A.F. in Egypt in 1943, which were temporarily disguised as civil machines *G-AGGJ* to *'HD* and given B.O.A.C. markings for an audacious delivery flight in camouflage from Croydon to Lisbon and thence to Aboukir via Takoradi and the trans-African route.

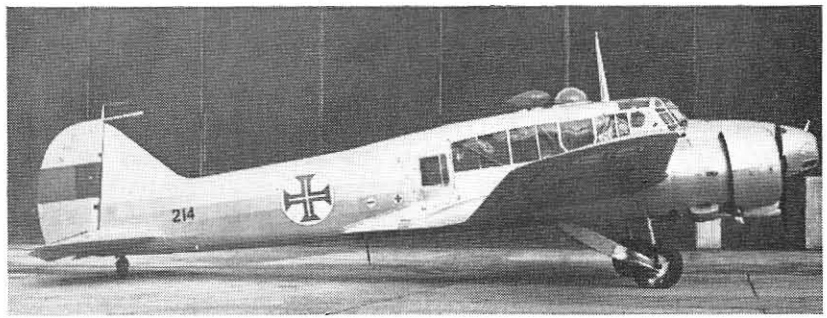
The all-up weight of the Anson was steadily increased from 7,342 lb. for the prototype in 1935, to 8,000 lb. in September 1938 when the crew was increased from 3 to 4, and to 9,300 lb. in 1941 (by which time the bomb load had been increased to two 250 lb. bombs), and finally to 9,850 lb. in 1943 for a number equipped with Bristol B.1 Mk. VI turrets as combined navigation and armament trainers. Engine-overheating then led to the fitting of smooth 'Oxford' type cowlings.

The Anson Mk. X (prototype *NK753*), introduced in 1943, was virtually a Mk. I with cabin floor strengthened to support heavy freight. Some early

production aircraft had full military equipment and the Bristol turret but the majority were without such adornment for Nos. 4 and 5 A.O.D.U. and Air Transport Auxiliary post D-Day freight runs to the Continent. Many Mk. Xs. had transparent nose caps and smooth engine cowlings, modifications retrospectively incorporated in a large number of Anson Mk. Is, a considerable fleet of which flew nearly ten million miles with the A.T.A. Air Movements Flight, distributing and collecting ferry pilots. Capt. Douglas Fairweather, founder of the Flight and former owner of Avro Cadet Special *G-ACIL*, was a middle-aged Anson devotee who chain-smoked his way through any weather to get his exhausted and sleeping loads back to base, often with Service hitch hikers 'strap hanging' in the gangway. He and a nursing sister lost their lives somewhere in the Irish Sea in Anson I *N4875* on April 4, 1944 while trying to reach Prestwick in appalling weather to pick up a serious hospital case.

After the war surplus Anson Mk. Is were sold in small numbers to the air forces of Belgium (e.g. *NA3* ex *EG208*), Egypt (e.g. *NK581*), Iran, Israel, Norway, the Netherlands (*D-1* to *D-9*), Portugal and Saudi Arabia. The largest number, 223, was sold to France to equip the Air Navigation and Bombing School at Cazoux, patrol squadrons in Syria and Equatorial Africa, the Advanced Flying School at Cognac, and the Aéronavale. While no Ansons were supplied direct to the British Royal Navy, a number were transferred from the R.A.F. postwar for Air Observer training.

With its quite remarkable reputation as a reliable and easily maintained work horse, the war surplus Anson Mk. I was the natural choice of countless small charter firms which sprang up in the years immediately following the war. This resulted in the civil registration of 98 in the U.K. and 140 in Australia alone. Similarly Anson Mk. Vs served Spartan Air Services Ltd., Ottawa, and other Canadian concerns for more than two decades and one, *OY-DZI*, was used as an ambulance in Denmark by Zone Redningskorpset.



Anson I *214*, an ex R.A.F. aircraft *NK437*, reconditioned at Woodford for the Portuguese Government in 1947.

Civil conversion was simply a matter of installing six or eight seats and reducing the enormous glazing to three or four square or circular windows on each side, although Air Service Training Ltd.'s *G-AHNS* and *'NT* remained in standard form for twin conversion and navigation training. Other long-term Anson users were the Fairey and Hunting survey organisations; the College of Aeronautics, who used three at Cranfield as flying laboratories and equipped *G-AIPC* for flight testing aerofoil sections above the cabin roof; the Cambridge University Aeronautical Laboratory, which used *MG467* for boundary layer suction experiments in 1950; and the Straight Corporation, who used 10 for school work and scheduled services. The tourist trade kept the Anson-equipped mushroom concerns in business for a year or two but lasting success came principally to Blue Line Airways Ltd., Tollerton, with five; British Air Transport Ltd., Redhill, with six; and Transair Ltd., Croydon, who at one time or another owned 11 Ansons, mainly windowless freighters for the early morning Continental mail and newspaper run prior to 1953.

Overseas the Anson gave sterling service with C.L. Air Surveys Ltd. in Kenya; Gulf Aviation Ltd., Bahrein; Nanyang Airways Ltd., Singapore; Trans Arabian Airways Ltd., Amman; and Airwork Ltd., Nairobi. Many were fitted with underwing spray bars or hoppers for agricultural work and pest control in North and Central Africa. Others were used for communications by oil companies in the French Sahara and flew in the markings of many South American, Asian and European countries.

Regrettably glued joints do not last indefinitely and the Anson's wooden mainplane inevitably deteriorated with age. Thus in 1960 when the A.R.B. decided to grant no more Cs. of A. to Anson Mks. I and X for passenger work, the old war horse rapidly disappeared from British skies, the last being *G-ALXC* and *G-AMBE* which landed their final loads of vegetables at Speke for the Federated Fruit Co. in April 1961; and Derby Aviation's *G-AMDA* which made a geophysical survey of Southern England with a towed magnetometer in 1954–5 and ended its flying career in 1962 as a twin trainer with the London School of Flying at Elstree before going to a museum at Staverton in 1963.

In Australia, where short lived enterprises had given the Anson an even more complex commercial history than in the U.K., the final ban came at midnight on June 30, 1962. The major Anson users, Flinders Island Airways Ltd. and Brain and Brown Ltd. of Moorabbin, Melbourne, had provided essential ferry services to Tasmania and the Bass Strait islands for many years with *VH-BSF*, *'FIA* and *'IC*; while in Western Australia, Woods Airways Ltd. had run the Perth–Rottnest Island link with *VH-WAB* and *'AC*. These and *VH-AGA*, *'BEL* and *'MMH* belonging to other taxi concerns were relegated to inland work when over-water passenger flights were banned on January 1, 1962. On the final day six months later, *VH-BSF*, *'FIA* and *'IC* made a farewell formation flight over Melbourne while *VH-BEL* and *'MMH* circled Perth together for the last time.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath and Chadderton, Manchester; Woodford Aerodrome, Cheshire; and Yeadon Aerodrome, Yorks.
Federal Aircraft Ltd., Montreal, Canada
Canadian Car and Foundry Co. Ltd., Amherst, Nova Scotia, and Cartierville, Montreal
de Havilland Aircraft of Canada Ltd., Downsview Airport, Toronto, Canada
National Steel Car Corporation, Malton, Ontario, Canada (later renamed Victory Aircraft Ltd.)
Ottawa Car and Aircraft Co. Ltd., Ottawa, Canada
McDonald Bros., Stevenson Field, Winnipeg, Canada

Power Plants:

(Avro 652)	Two 270 h.p. Armstrong Siddeley Cheetah V
(Avro 652 Mk. II)	Two 310 h.p. Armstrong Siddeley Cheetah IX
(Avro 652A prototype)	Two 290 h.p. Armstrong Siddeley Cheetah VI
(Anson Mk. I)	Two 335 h.p. Armstrong Siddeley Cheetah IX
	Two 395 h.p. Armstrong Siddeley Cheetah XIX
(Anson Mk. II)	Two 330 h.p. Jacobs L6MB
(AT-20)	Two 330 h.p. Jacobs R-915-7
(Anson Mk. III)	Two 330 h.p. Jacobs L6MB
(Anson Mk. IV)	Two 300 h.p. Wright Whirlwind R-760-E1
(Anson Mks. V and VI)	Two 450 h.p. Pratt and Whitney Wasp Junior R985-AN12B (automatic mixture control) or AN14B (manual control)

Dimensions: Span 56 ft. 6 in. Length 42 ft. 3 in.
Height 13 ft. 1 in. Wing area 463 sq. ft.

Weights and Performances:

	Avro 652	Anson I	Anson V and VI	Anson X
Tare weight	5,100 lb.	5,375 lb.	6,693 lb.	—
All-up weight	7,400 lb.	7,663 lb.*	9,460 lb.	9,450 lb.
Maximum speed	195 m.p.h.	188 m.p.h.	190 m.p.h.	175 m.p.h.
Cruising speed	165 m.p.h.	158 m.p.h.	145 m.p.h.	140 m.p.h.
Initial climb	770 ft./min.	960 ft./min.	1,500 ft./min.	—
Ceiling	21,500 ft.	19,000 ft.	21,450 ft.	—
Range	790 miles	660 miles	580 miles	—

*Avro 652 Mk. II, Anson G.R. Mk. I, Anson Mk. II and Mk. III 8,000 lb.

Production:

(*a*) **By A. V. Roe and Co. Ltd.**

Avro 652: Two aircraft for Imperial Airways Ltd.

G-ACRM "Avalon", c/n 698, C. of A. issued 1.3.35; to Air Service Training Ltd. 7.38; impressed 2.41 as *DG655*; to No. 811 Sqn. 7.41

G-ACRN "Avatar" (changed to "Ava"), c/n 699, C. of A. issued 8.3.35; to Air Service Training Ltd. 7.38; impressed 2.41 as *DG656*, damaged in ground collision with Chesapeake, Lee-on-Solent 1.10.41

Avro 652 Mk. II: One aircraft for the Egyptian Army Air Force.

SU-AAO, c/n 891 (duplicating c/n of Greek Avro 621 serial *E-50*), C. of A. issued 4.11.36; to Egyptian Army Air Force as *W204*

Avro 652A Prototype: One aircraft to Air Ministry Specification G.18/35.

K4771, first flown at Woodford 24.3.35; to Martlesham 13.4.35; Service trials, Gosport 11–17.5.35; Hendon R.A.F. Display 29.6.35; at Martlesham till 1937; at R.A.E., Farnborough 8.39

First R.A.F. production batch of 174 aircraft to amended Specification 18/35 under Contract No. 421119/35: *K6152–K6325* (*K6212–K6223* to the R.A.A.F. as *A4-1* to *A4-12*, c/n 967–978).

Second R.A.F. production batch of 106 aircraft ordered 1936 under Contract No. 497338/36: *K8742–K8847* (*K8792–K8812* to the R.A.A.F. as *A4-13* to *A4-33*, c/n 1008–1028; *K8840–K8844* as *A4-34* to *A4-38*, c/n 1053–1057)

Third R.A.F. production batch of 39 aircraft delivered 28.7.37–25.10.37 under Contract No. 497339/36: *K8703–K8741* (*K8738–K8740* to Finland as *AN101–AN103*, c/n 939–941; *K8741* to Estonia as *158*, c/n 951)

Irish Army Air Corps batch of four aircraft ordered 1937: *A.19* and *A.20*, c/n 980–981, delivered ex Woodford 20.3.37; *A.21* and *A.22*, c/n 1033–1034, delivered ex Woodford 19.1.38

Fourth R.A.F. production batch of 28 aircraft ordered 1937 under Contract No. 633200/37: *L7046–L7073*

Fifth R.A.F. production batch of 98 aircraft ordered 1937 under Contract No. 690658/37, the first in which the serial 'black out' technique was used: *L7903–L7932*, *L7945–L7977*, *L7991–L7994*, *L9145–L9165*, *N1330–N1339* (*L7913–L7922* to the R.A.A.F. as *A4-39* to *A4-48*, c/n 1079–1088)

Royal Hellenic Air Force batch of 12 aircraft ordered 1938: *TT51–TT62*, flown out as *G-AFTU* to *G-AFTW*, *G-AFUH* to *G-AFUJ*, *G-AFUM* to *G-AFUO*, and *G-AFUR* to *G-AFUT*, c/n 1111–1122, Cs. of A. issued between 12.5.39 and 15.6.39

Sixth R.A.F. production batch of 850 aircraft ordered 1938 under Contract No. 766119/38: *N4856–N4899*, *N4901–N4948*, *N4953–N4989*, *N4995–N5044*, *N5047–N5094*, *N5096–N5125*, *N5130–N5178*, *N5182–N5220*, *N5225–N5274*, *N5279–N5318*, *N5320–N5359*, *N5361–N5385*, *N9526–N9575*, *N9587–N9621*, *N9640–N9689*, *N9713–N9752*, *N9765–N9790*, *N9815–N9858*, *N9870–N9919*, *N9930–N9956*, *N9972–N9999* (*N9947–N9952*, c/n 1127–1132, to Turkey 5.40)

Seventh R.A.F. production batch of 200 aircraft ordered 1939 under Contract No. B12565/39: *R3303–R3351*, *R3368–R3413*, *R3429–R3476*, *R3512–R3561*, *R3581–R3587*

Eighth R.A.F. production batch of 300 aircraft ordered 1939 under Contract No. B32842/39: *R9567–R9611*, *R9627–R9670*, *R9685–R9725*, *R9739–R9781*, *R9798–R9846*, *R9864–R9899*, *R9928–R9969*

Ninth R.A.F. production batch of 1,000 aircraft ordered 1939 under Contract No. 61695/39: *W1505–W1524*, *W1529–W1540*, *W1544–W1570*, *W1576–W1618*, *W1627–W1676*, *W1690–W1736*, *W1751–W1800*, *W1814–W1863*, *W1875–W1924*, *W1932–W1971*, *W1986–W2025*, *W2031–W2072*, *W2078–W2099*, *W2109–W2158*, *W2163–W2212*, *W2216–W2245*, *W2252–W2291*, *W2298–W2347*, *W2355–W2398*, *W2403–W2452*, *W2457–W2592*, *W2598–W2646*, *W2651–W2665*

Tenth R.A.F. production batch of 1,770 complete Anson Mk. Is, 57 Mk. I airframes and 223 Mk. IV airframes ordered 1940 under Contract No. B137211/40: *AW443–AW492*, *AW506–AW540*, *AW586–AW635*, *AW653–AW697*, *AW739–AW758*, *AW778–AW812*, *AW833–AW882*, *AW897–AW941*, *AW963–AW982*, *AX100–AX149*, *AX163–AX187*, *AX218–AX267*, *AX280–AX324*, *AX343–AX372*, *AX396–AX445*, *AX466–AX515*, *AX535–AX584*, *AX607–AX656*, *DG689–DG737*, *DG750–DG787*, *DG799–DG844*, *DG857–DG880*, *DG893–DG942*, *DG956–DG987*, *DJ103–DJ149*, *DJ162–DJ190*, *DJ205–DJ248*, *DJ263–DJ298*, *DJ314–DJ361*, *DJ375–DJ417*, *DJ430–DJ478*, *DJ492–DJ529*, *DJ545–DJ589*, *DJ603–DJ639*, *DJ656–DJ700*, *EF805–EF839*, *EF858–EF890*, *EF903–EF941*, *EF952–EF993*, *EG104–EG148*, *EG165–EG195*, *EG208–EG246*, *EG251–EG280*, *EG293–EG335*, *EG350–EG396*, *EG412–EG447*, *EG460–EG507*, *EG524–EG561*, *EG583–EG616*, *EG629–EG655*, *EG672–EG704*

Eleventh R.A.F. production batch increasing Contract No. B137211/40 by 1,550 Anson Mk. I aircraft: *LS978–LS999*, *LT112–LT160*, *LT175–LT210*, *LT231–LT258*, *LT271–LT307*, *LT334–LT378*, *LT410–LT459*, *LT472–LT503*, *LT521–LT549*, *LT575–LT610*, *LT641–LT682*, *LT701–LT745*, *LT764–LT797*, *LT823–LT849*, *LT872–LT899*, *LT921–LT961*, *LT978–LT999*, *LV122–LV167*, *LV199–LV230*, *LV252–LV300*, *LV313–LV332*, *MG102–MG147*, *MG159–MG199*, *MG214–MG256*, *MG270–MG314*, *MG327–MG368*, *MG381–MG423*, *MG436–MG478*, *MG490–MG536*, *MG549–MG596*, *MG613–MG656*, *MG669–MG701*, *MG714–MG757*, *MG770–MG813*, *MG826–MG874*, *MG888–MG928*, *MG962–MG999*, *MH103–MH135*, *MH149–MH196*, *MH210–MH237* (23 diverted to the R.N.Z.A.F. as *NZ401–NZ423* included *LT349/NZ410*, later civil as *ZK-BCL*)

Twelfth R.A.F. production batch increasing Contract No. B137211/40 by a further 800 Anson Mk. I aircraft: *NK139–NK187*, *NK199–NK244*, *NK260–NK303*, *NK315–NK356*, *NK368–NK406*, *NK419–NK462*, *NK475–NK516*, *NK528–NK568*, *NK581–NK623*, *NK636–NK679*, *NK692–NK738*, *NK750–NK793*, *NK806–NK848*, *NK861–NK906*, *NK919–NK958*, *NK970–NK999*, *NL112–NL155*, *NL169–NL208*, *NL220–NL251*

Avro 652A Anson Mk. I aircraft ferried to Egypt in B.O.A.C. markings 1943: *G-AGGJ* to *G-AGGP* and *G-AGGR* to *G-AGHD*, temporarily demilitarised with c/n 1152–1171, Cs. of A. issued 3.6.43 to British Overseas Airways Corporation. The aircraft reverted to military serials *LT191*, *192*, *203*, *204*, *236*, *255*, *256*, *257*, *307*, *340*, *EG677*, *LS985*, *LT279*, *115*, *176*, *234*, *276*,

281, *EG651* and *LS989* respectively on arrival at Aboukir. (Note: c/n of *G-AGGJ* duplicates that of the final Egyptian Avro 626)

Avro 652A Anson Mk. X

(i) 103 aircraft laid down as Anson Mk. Is but completed as Ansons Mk. Xs: *NK352–NK354*, *NK356*, *NK368–NK369*, *NK426–NK428*, *NK431–NK433*, *NK438–NK439*, *NK443*, *NK446–NK449*, *NK487–NK493*, *NK528–NK534*, *NK657–NK661*, *NK664–NK668*, *NK695*, *696*, *699*, *700*, *703*, *705*, *706*, *722*, *725*, *728*, *731*, *734*, *737*, *751*, *NK766–NK772*, *NK775*, *778*, *781*, *784*, *786*, *787*, *789*, *791*, *793*, *819*, *820*, *823*, *824*, *827*, *828*, *831*, *832*, *835*, *838*, *841*, *844*, *847*, *862*, *865*, *920*, *921*, *924*, *925*, *NK930–NK935*, *NL112–NL116*

(ii) 17 Anson Mk. Is converted to Anson Mk. Xs after delivery: *AW871*, *MG471*, *MH192*, *MH231*, *NK178*, *183*, *234*, *262*, *500*, *567*, *702*, *707*, *710*, *712*, *716*, *727* and *814*

Note: All British-built Ansons were constructed at Newton Heath with the exception of *W2612–W2646*, *W2651–W2665*, *DG689–DG727*, and all *EF*, *EG*, *LS*, *LT*, *LV*, *MG*, *MH*, *NK* and *NL* batches which were built at Yeadon.

(*b*) Anson Mk. II aircraft for the Royal Canadian Air Force

Serial range	Manufacturer	Serial range	Manufacturer
7069	Federal	8404–8463	Ottawa Car
7070–7173	Canadian Car	8464–8648	McDonald Bros.
7174–7498	de Havilland	11181–11281	Canadian Car
7499–7622	National Steel	11282–11380	McDonald Bros.
8203–8353	National Steel	11381–11580	Victory Aircraft
8354–8403	Canadian Car		

(*c*) AT-20 aircraft for the United States Army Air Forces

43-8181 to *43-8230*, fifty aircraft procured in the fiscal year 1943.

(*d*) Anson Mk. V aircraft for the Royal Canadian Air Force

Serial range	Manufacturer	Serial range	Manufacturer
8649	Federal	11681–11930	Canadian Car
11581	Canadian Car*	11931–12628	McDonald Bros.
11582–11630	Canadian Car	13231–13250	Canadian Car
11631–11680	McDonald Bros.		

Note: All Canadian Car and Foundry production at Amherst, Nova Scotia, except * at Cartierville.

(*e*) The Anson Mk. VI

One aircraft only, R.C.A.F. serial *13881*, built by Federal Aircraft Ltd.

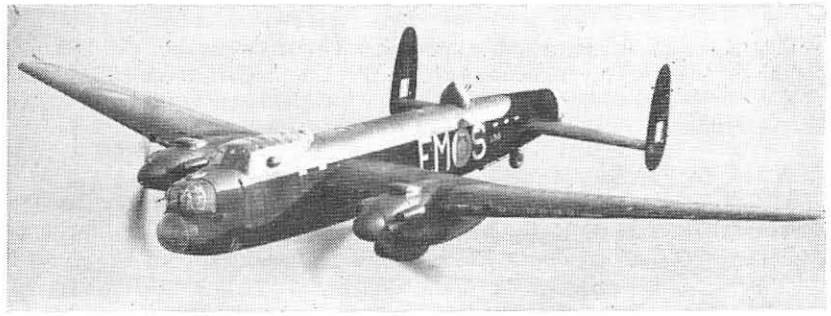
(*f*) Reconditioned aircraft

Ten ex R.A.F. Anson Mk. Is reconditioned by A.V. Roe and Co. Ltd. 5.47 for the Portuguese Government as *213* to *222*, c/n 1334–1339 (ex *NK182*, *437*, *444*, *476*, *483* and *484*); and c/n 1370-1373 (ex *MG690*, *692*, *696* and *221*) to Works Orders 35970 and 36651

Service Use: (Units which used the Anson in numbers, with codes in parentheses)

Coastal Command: Nos. 42 (AW), 48 (XZ), 86 (BX), 206 (WD, VX), 217 (YQ, MW), 220 (HU), 221, 224 (PW), 233 (EY), 269 (WP, UA), 320 (TD), 321, 500 (SQ, MK), 502 (KQ, YG), 608 (PG, OY) and 612 (DJ) Squadrons; Nos. 1, 3, 6 and 8 O.T.U.s; No. 3 School of General Reconnaissance; No. 1693 Flight. *Bomber Command:* Nos. 7 (MG), 51, 58, 61, 109 (ZP, HS), 144 (PL) and 148 (BS) Squadrons; Nos. 1 to 6 Bomber Group Pools; Nos. 10 (UY), 11 (TX), 12, 13 (SL), 14, 15, 16 (GA), 17 (WJ) and 19 (XF) O.T.U.s. *Fighter Command:* No. 62 O.T.U. *Air Sea Rescue:* Nos. 275, 276 (AQ), 278 (MY), 280 (MF, YF), 281 (FA), 282 and 293 Squadrons. *Special Duties:* Nos. 138 and 161 Squadrons (agent recovery), No. 1473 Flight (radio counter-measures), Nos. 516 and 544 Squadrons (Combined Operations). *Training Units:* Nos. 6, 7, 11, 12, 15, 16, 18, 28, 29, 33, 37 and 39 E. and R.F.T.S.; A.S.T., Hamble; C.F.S. and Air Navigation School (prewar); Nos. 6, 9, 10 and 11 Flying Training Schools; Nos. 2, 3, 4, 7, 8, 10, 12 and 13 Air Gunners Schools; Nos. 2, 3, 4, 5, 7 and 12 Air Observers Schools; Nos. 3, 5, 6, 7, 11, 14, 15, 17, 18 and 20 (Pilot) Advanced Flying Units; Nos. 1, 7 and 10 (Observers) Advanced Flying Units; Nos. 10 and 11 Radio Schools; No. 1 Staff Pilots Training Unit; Nos. 2 (FFM), 3 (Z), 5 (FFI), 7 (FFN) and 10 (FFT) Air Navigation Schools; No. 19 Flying Training School (FAG) (postwar); School of Air Traffic Control (FDY); Central Navigation School. *Air Transport Auxiliary:* Nos. 1 to 16 Ferry Pools and the Air Movements Flight. *Commonwealth Air Training Plan:* Flying schools in Canada, Australia, South Africa, Southern Rhodesia and New Zealand. *R.A.A.F. Coastal Patrol:* Nos. 1, 2, 6, 12, 13, 14, 21, 22, 23, 25, 33, 34, 35, 66, 67, 71, 73 and 92 Squadrons. *S.A.A.F.:* Nos. 31, 32 and 33 Flights, Nos. 35 and 60 Squadrons. *Miscellaneous Units:* Nos. 510 (later the Metropolitan Communications Sqn.) and 575 Squadrons; Middle East Communications Squadron; Free French Group Artois (West Africa). *Royal Navy:* No. 758 Squadron; Air Observers School.

Ansons were also used singly or in small numbers by numerous Station Flights and other units, and in the early postwar years the Anson Mk. I was used by the R.A.F. College, Cranwell and many of the re-formed Reserve Flying Schools.



Avro 679 Manchester IA *L7515* of No. 207 Squadron.

Avro 679 Manchester

Second Avro type to bear the name Manchester, the Avro 679 was designed in 1937 to Specification P.13/36, in which the Air Ministry outlined its requirements for a new generation of twin engined medium bombers. Of the several tenders received, only the Avro 679 and Handley Page H.P.56 were selected for construction and contracts were placed for two prototypes of each. Power plants in each case were the new and untried Rolls-Royce Vulture 24 cylinder, X-type watercooled engines. Nominally of 1,760 h.p., but developing 1,845 h.p. in low supercharger gear at 5,000 ft., these were the largest engines produced by Rolls-Royce Ltd. and consisted of two Peregrine engines (ultimate development of the famous Kestrel), mounted on a common crankcase and developing almost double the power of the Merlin. As sufficient Vulture engines were not ready in time, the H.P.56 was abandoned in 1937 in favour of a four Merlin version later built in quantity as the H.P.57 Halifax. This left the Manchester as the successful tender to the Specification and in 1938 a large production programme was initiated at Manchester.

Manned by a crew of seven, the Manchester was an advanced aeroplane weighing more than 20 tons and capable of carrying heavy bomb loads at high speed. It was a mid-wing, all-metal, cantilever monoplane with two spar, flush riveted wing and semi-monocoque fuselage of flattened circular section. The flight crew was grouped in a forward cabin under a transparent canopy fitted with bullet-proof glass panels, warmed by air ducted from a small coolant radiator in the wing. The captain and fire controller sat on the port side, the navigator farther aft at a chart table to starboard, and the radio operator in the rear near the astrodome. Armament on production aircraft consisted of eight ·303 Browning guns in Nash and Thompson hydraulically driven nose, tail and dorsal turrets, while the bottom of the centre fuselage was one vast bomb bay closed by hydraulically operated doors. The powerful hydraulic system (an entirely novel feature in those days), also retracted the large Dowty undercarriage and operated split trailing edge flaps, radiator and

air intake shutters. Bomb loads varied inversely with the range, the maximum for each being five tons (11,200 lb.) and 2,000 miles respectively.

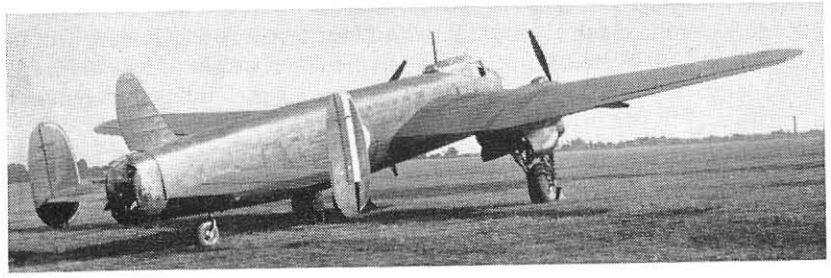
Avro chief test pilot H. A. Brown captained the unarmed prototype *L7246* on its maiden flight at Ringway on July 25, 1939 but after tests at Boscombe Down a shark-style central fin was fitted to the twin ruddered tail. Much of the prototype's life was spent at the R.A.E., Farnborough, in perfecting a catapult launching and arrested landing technique which was specially designed for the Manchester but, in the end, never used.

A second prototype, *L7247*, flown at Ringway on May 26, 1940 was armed with six ·303 guns in Fraser Nash nose, tail and ventral turrets. The last was quickly replaced by an F.N.7 Botha-type dorsal turret, cut down in height to reduce drag, and the crude central fin was soon replaced by a more rounded wide chord unit. At the same time, metal covered ailerons and elevators were replaced on both prototypes by fabric covered components, *L7247* also having experimental servo elevator balance tabs and new wing tips which increased the span by 9 ft. 11 in. to 90 ft. 1 in.

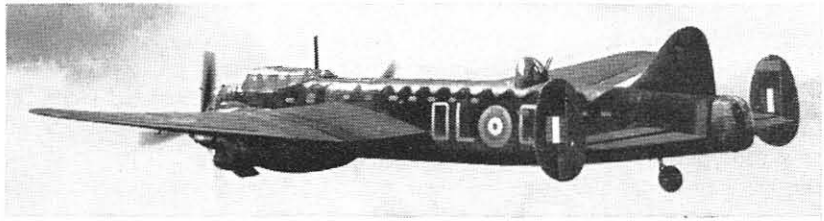
Production of the Manchester I to Specification 19/37 commenced in July 1939 with a contract for 200, deliveries commencing with *L7276* on August 5, 1940. Construction also began at the new Metropolitan-Vickers works at Trafford Park, Manchester, but on December 23, 1940 the first Metro-Vick machine, together with twelve others on the production



L7246, first prototype Manchester with original twin ruddered tail unit. (*Crown Copyright Reserved.*)



L7247, second prototype Manchester with early form of central fin. (*Crown Copyright Reserved.*)



A Manchester I of No. 83 Squadron.

line and valuable tools and jigs, were destroyed by German bombing.

The Service career of the Manchester began in November 1940 with No. 207 Squadron, Waddington, Lincs., where the station C.O., the late Air Marshal Sir John Boothman, quickly discovered that rotation of the dorsal turret in flight disturbed the airflow and set up destructive vibration in the central fin. Nevertheless the Manchester was a fine aircraft with handling qualities which drew unstinted praise from pilots. Its first operational flight to Brest on the night of February 24–25, 1941 was followed by participation in the 1,000 bomber raid on Cologne and regular operations over Germany which culminated in the award of a Victoria Cross to F/Lt. L. T. Manser, captain of *L7301* of No. 50 Squadron, for his part in a raid on May 30, 1942.

Similar in layout to the Vulture, the 2,100 h.p. Napier Sabre was suggested as an alternative power plant for a projected Manchester II but although one airframe was delivered to D. Napier and Son Ltd. at Luton, the scheme was dropped before the engines were installed. With wings removed the aircraft then became a Sabre engine test stand. Another version of the Manchester II with two 2,520 h.p. Bristol Centaurus radials actually had the engines installed, but was not flown due to preoccupation with the more attractive Manchester III. This was a standard Manchester fitted by agreement with the Air Ministry with a redesigned centre section carrying two 1,145 h.p. Rolls-Royce Merlins Xs, and new outer wing sections mounting two further Merlins. Serialled *BT308*, this aeroplane became the first prototype Avro 683 Lancaster, but during trials at Boscombe Down and in the light of operational experience by No. 207 Squadron, was fitted with a 33 ft. span tailplane with enlarged twin fins. The new tail proved superior to the old triple fin arrangement and was fitted retrospectively to all Manchester Is which then became Manchester IAs, cleared for take-off at an increased weight of 56,000 lb. and armed with two nose, two dorsal and four tail guns. Integral fuel tanks, unsatisfactory in combat, were also replaced by the self-sealing variety.

Recurrent failure of the insufficiently developed Vulture engine unfortunately brought the career of this promising aeroplane to a premature end. Absolute priority given to Merlin production made it impossible for the manufacturers to divert any of their resources to eliminating Vulture teething troubles (such as the fatigue failure of connecting rod bolts) and production was discontinued. Manchester deliveries therefore ceased when Avro had

built 157 and Metropolitan-Vickers 43, their last Bomber Command operation being a raid on Bremen during the night of June 25–26, 1942.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; and Woodford Aerodrome, Cheshire
Metropolitan-Vickers Ltd., Trafford Park, Manchester

Power Plants:

(Manchester I and IA)	Two 1,760 h.p. Rolls-Royce Vulture I
(Manchester II)	Two 2,100 h.p. Napier Sabre I
	Two 2,520 h.p. Bristol Centaurus
(Manchester III)	Four 1,145 h.p. Rolls-Royce Merlin X

Dimensions, Weights and Performances:

	Prototypes	Manchester I	Manchester IA
Span	80 ft. 2 in.	90 ft. 1 in.	90 ft. 1 in.
Length	68 ft. 4 in.	68 ft. 10 in.	68 ft. 10 in.
Height	19 ft. 6 in.	19 ft. 6 in.	19 ft. 6 in.
Wing area	1,057½ sq. ft.	1,131 sq. ft.	1,131 sq. ft.
Tare weight	25,959 lb.	—	—
All-up weight	45,000 lb.	50,000 lb.	56,000 lb.
Cruising speed	294 m.p.h.	—	—
Ceiling	—	19,200 ft.	—
Range	—	1,630 miles*	—

*Maximum range, bomb load 8,100 lb. With maximum load of 10,350 lb., range 1,200 miles.

Production:

Prototypes: Two aircraft ordered 8.9.36 to Air Ministry Specification P.13/36 under Contract No. 624973/37 and built to Works Order 5667: *L7246*, first flown at Ringway 25.7.39; *L7247*, first flown at Ringway 26.5.40

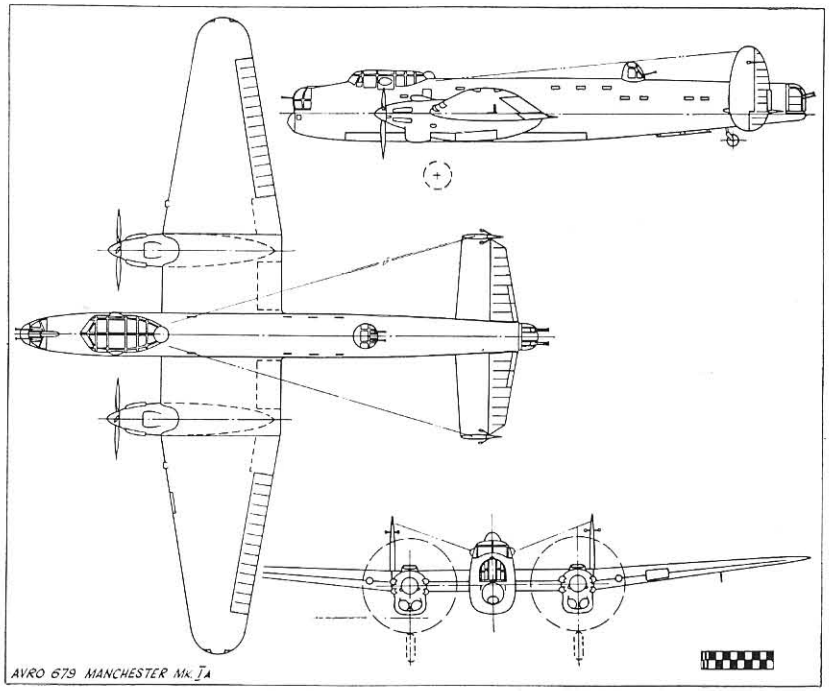
Built by A. V. Roe and Co. Ltd. to Works Order No. 5723: Order placed 12.37 to Air Ministry Specification 19/37 under Contract No. B648770/37. Delivered from 31.7.40 as Manchester I and from *L7420* as IA, production terminated at 156 aircraft. *L7276–L7325*, *L7373–L7402*, *L7415–L7434*, *L7453–L7497*, *L7515–L7526*. (*L7517* damaged by fire 19.11.41 and deleted from Contract) *L7285*, *L7289*, *L7293* and *L7297*, diverted to Contract No. B10962/39 for armament development, were returned to the original Contract and completed and delivered as standard Manchester Is.

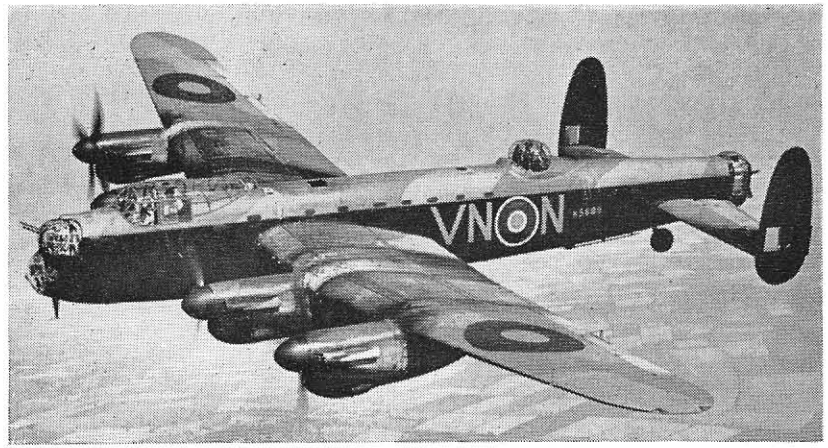
Built by Metropolitan-Vickers Ltd. to Works Order No. 8060: Order placed 1939 to Air Ministry Specification 19/37 for 100 Manchester Is under Contract No. B108750/40. Delivered to A. V. Roe and Co. Ltd. for assembly and test from 10.3.41, but production terminated at 44 aircraft. *R5768–R5797*, *R5829–R5841*. (*R5768–R5780* were destroyed on the production line by enemy bombing 23.12.40, and new machines were given the same serials at the end of the Contract, *R5768–R5776* assembled at Woodford and the remainder at Ringway.)

Conversions to Manchester Mk. IA by A. V. Roe and Co. Ltd.: *L7276, '77, '79–'94, '96–'99, L7301, '05, '08, L7385, '86, '89–'91, '94–'98, L7417, '18*
By Rollaston Aviation Ltd. and Tollertons Ltd.: *L7399–L7402, '15, '16*

Trials aircraft: A. V. Roe and Co. Ltd. *L7280* (F. N. turret), *L7281* (trial modifications), *'87, L7305, '20, '97*; A. and A.E.E., Boscombe Down *L7276, '77, '81, L7320, R5380*; A.F.D.U., Wittering *L7303*; A.F.E.E. *L7392*; R.A.E., Farnborough *L7279, '85, L7400*; Rolls-Royce Ltd., Hucknall *L7293, '95* for flame damper tests (burned out 26.5.41), *'97*; T.D.U., Gosport *L7276, '92, R5773, '74*

Service Use: (with squadron codes in parentheses and giving representative serial numbers).
Bomber Command Squadrons. No. 9: *L7386, L7425, R5784, R5838*. No. 44: *L7382, L7430, R5790*. No. 49 (EA): *L7281, L7387, L7420, L7524, R5771, R5836*. No. 50 (VN): *L7289, L7301, L7415, L7516, R5778, R5833*. No. 57: *L7460, R5796*. No. 61 (QR): *L7276, L7307, L7426, L7518, R5787, R5832*. No. 83 (OL): *L7285, L7385, L7418, L7522, R5768, R5830*. No. 97 (OF): *L7282, L7306, L7421, R5783*. No. 106 (ZN): *L7390, L7417, L7515, R5770, R5839*. No. 207 (EM): *L7278, L7300, L7419, L7523, R5782*. No. 408: *L7401, R5835*. No. 420: *L7402, R5769*. Training Units: No. 25 O.T.U.; Nos. 1654, 1656, 1660, and 1661 H.C.U.; No. 1485B. and G.S.





Avro 683 Lancaster I *R5689* of No. 50 Squadron. (*'The Aeroplane' Photo.*)

Avro 683 Lancaster

In a letter to A. V. Roe and Co. Ltd. in December 1945 Air Chief Marshal Sir Arthur Harris, chief of Bomber Command, declared that the Lancaster was the greatest single factor in winning the Second World War. This undoubted truth, based on the fact that the Lancaster delivered 608,612 tons (or two thirds of the total bomb load dropped after the beginning of 1942), was the more remarkable when it is remembered that the aircraft came into existence almost fortuitously as a direct result of the failure of the twin engined Manchester. Arising from the urgent need to replace the Vulture engines, one standard Manchester airframe, complete with central fin and 22 ft. span tailplane (but without dorsal turret), was fitted with four underslung 1,145 h.p. Rolls-Royce Merlin X engines. First referred to as the Manchester III, and finally as the Lancaster prototype, it was serialled *BT308*, first flown at Woodford on January 9, 1941 and delivered to the A. and A.E.E., Boscombe Down, for acceptance tests on January 27. Prior to major trials, however, the central fin was removed and the aircraft fitted experimentally with large twin oval fins at the ends of a 33 ft. span tailplane. A second, or 'productionised' prototype, *DG585*, was flown on May 13, 1941 and thereafter all airframes laid down as Manchesters were completed as Lancasters.

Powered by four 1,280 h.p. Merlin XXs, the first production Lancaster I, *L7527*, flew for the first time at Woodford on October 31, 1941. It was equipped with de Havilland three bladed, constant speed, fully feathering airscrews; internal wing tanks of 2,154 gallons total capacity; nose, tail, dorsal and ventral turrets; and self-inflating dinghy. Entry was via a ladder to

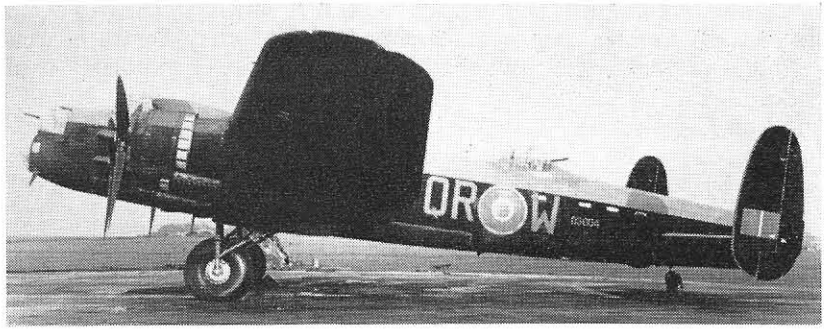
a door in the starboard side of the rear fuselage. With 7,000 lb. of bombs in its capacious vitals and operating at a maximum loaded weight of 65,000 lb., the Lancaster I had a maximum range of 2,530 miles and a performance so outstanding that production far in excess of the original Manchester contracts was straightway initiated. Construction on such a scale was made possible by the formation of the Lancaster Group of shadow factories tooled up by Sir W. G. Armstrong Whitworth Aircraft Ltd., Austin Motors Ltd., Metropolitan-Vickers Ltd. and Vickers-Armstrongs Ltd. To supplement output at Woodford, the parent company opened a second factory at Yeadon, Yorks. where Their Majesties King George VI and Queen Elizabeth named Lancaster Is *R5489* and *R5548* "George" and "Elizabeth" respectively on March 26, 1942. By the end of the war the full total of completed Lancasters reached the impressive figure of 7,374 and peak monthly production reached in August 1944 was 293 exclusive of spares.

No. 44 (Rhodesia) Squadron, Waddington, which received the Lancaster prototype *BT308* for crew training in September 1941, later became the first Lancaster squadron, the first operational sortie being to lay mines in Heligoland Bight on March 3, 1942. The prototype was then transferred to the R.A.E., Farnborough, for ballistics experiments and in 1943 was used by the National Gas Turbine Establishment to air test a Metro-Vick F2/1 jet engine mounted in the tail. The second Lancaster squadron, No. 97 based at Woodhall Spa, joined with No. 44 on April 17, 1942 in sending 12 machines on the first of the Lancaster's innumerable spectacular raids, a low level daylight attack on the M.A.N. diesel factory at Augsburg in which seven Lancasters were shot down and Sq. Ldr. J. D. Nettleton was awarded the Victoria Cross. The great daylight raid on the Le Creusot arms factories on October 17, 1942 by Nos. 49 and 57 Squadrons, was also the work of Lancaster Is. They also inaugurated the first of several new and revolutionary bombing techniques when No. 83 Squadron and the Pathfinder Force raided Flensburg on the night of August 18–19, 1942.

To ensure continuous Lancaster production in the event of an interruption in Merlin supplies, provision was made for the alternative installation of 1,650 h.p. Bristol Hercules VI radial engines. *DT810*, the first with Hercules,



Lancaster prototype *BT308* with the original Manchester-type tail assembly. (*Crown Copyright Reserved.*)



Lancaster II, four Bristol Hercules VI, *DS604* of No. 61 Squadron.

Avro-built and designated Lancaster II, had a top speed of 270 m.p.h. and a large contract was therefore placed with Armstrong Whitworth who delivered the first production Lancaster II, *DS601*, in October 1942. It transpired that Merlins remained in plentiful supply and as the Hercules was needed urgently elsewhere, the Lancaster II contract was repeatedly cut back until the total built was but 300. They remained in service over Europe with Nos. 61, 115, 408, 426, 432 and 514 Squadrons until the autumn of 1944 and also with Nos. 1668 and 1678 Heavy Conversion Units.

Apart from minor changes such as the gradual filling in of the 13 small slit windows on each side and the fitting of bulged bomb doors, the Lancaster airframe remained virtually unchanged throughout its life. Thus the Lancaster III with American-built Packard Merlin 28 engines was outwardly identical to the Mk. I and the first Lancaster III, *W4114*, was forerunner of 2,990 examples built to supplement Lancaster I production. They were, in turn, augmented by 430 Lancaster Xs, a version of the Packard Merlin Lancaster III built by Victory Aircraft Ltd. at Malton, Canada, and ferried across the Atlantic to be fitted with turrets and issued to the R.A.F. or British-based R.C.A.F. units. The first, flown on August 6, 1943 (16 months after the receipt of drawings), made a 9 hr. 30 min. Atlantic crossing to the U.K. on September 17.

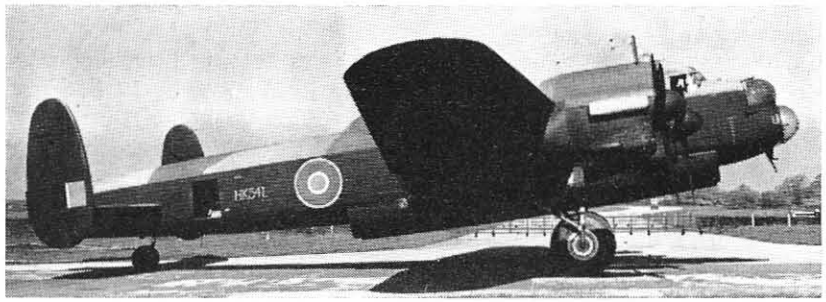
Without doubt the war's finest Lancaster epics were the breaching of the Möhne and Eder dams on the night of May 16–17, 1943 by 17 Lancaster IIIs of No. 617 Squadron, Scampton, led by Wing Cdr. Guy Gibson (who won the V.C.); and the sinking of the German battleship *Tirpitz* in a Norwegian fjord on November 12, 1944 by a combined force of 31 Lancasters of Nos. 9 and 617 Squadrons under Wing Cdr. J. B. Tait. The celebrated 'Dam Busters' used special low flying techniques (developed by *ED817* with cutaway belly) and a type of revolving cylindrical skip bomb invented by Dr. Barnes N. Wallis, but the *Tirpitz* was sunk by a single 12,000 lb. "Tallboy" bomb which the Lancaster alone could carry. Commencing with the 8,000 lb.

bombs dropped on Essen on the night of April 10–11, 1942, the vast bomb bay of the Lancaster was progressively adapted to carry bombs of ever increasing size, culminating in the fearsome 22,000 lb. "Grand Slam" used by Sq. Ldr. C. C. Calder to destroy the Bielefeld Viaduct from a No. 617 Squadron Lancaster on March 14, 1945. Aircraft modified to carry a single 8,000 lb., 12,000 lb. or 22,000 lb. bomb carried no H2S radar and were powered by Merlin 22s or 24s under the designation Lancaster B. Mk. 1 (Special).

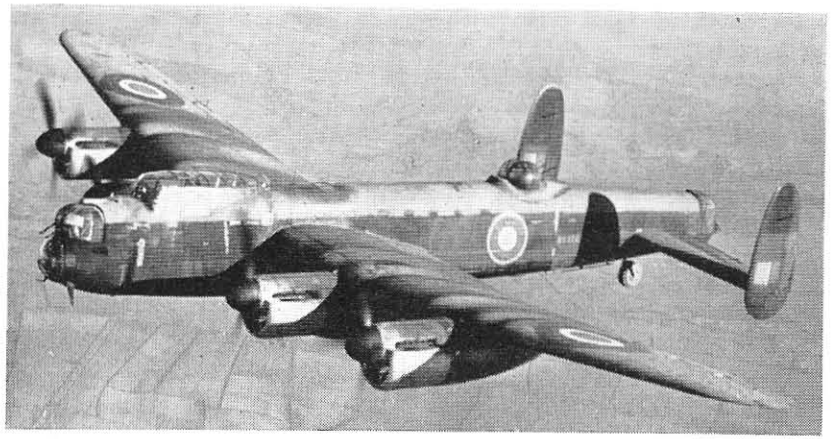
Development beyond the major Lancaster I/III/X sequence was directed towards increasing the range for operation in the Far East against Japan. Mock-ups of 1,200 gallon saddle tanks, fitted on top of the centre fuselage, were test flown on Lancaster Is *HK541* and *SW244*, but the scheme was dropped in favour of a plan to refuel en route from tanker aircraft equipped with apparatus manufactured by Flight Refuelling Ltd. Designs were also put in hand for extensively redesigned long range versions with Merlin 68s and 85s to be known as the Lancaster IV and V. These were to be fitted with a Bristol B.17 turret mounting two 20 mm. cannon, the trial installation for which was made in Lancaster III *JB456* in May 1944. Orders for 250 aircraft were placed with Vickers-Armstrongs Ltd. but all were cancelled at the end of 1944 as by that time the designs had been finalised as the Lincoln I and II. A similar fate befell the Avro 684 and 686 high altitude Lancaster replacement projects with four Rolls-Royce Merlin engines.

There were various attempts at improving the Lancaster's already impressive fire power, including trials with Mk. I *LL780* and Mk. III *RF268* with 20 mm. cannon in dorsal and ventral barbettes remotely controlled from a rear aiming position. Revised armament was not introduced, however, until the Lancaster VII which had two ·50 calibre guns in a Glenn Martin dorsal turret situated farther forward than the Nash and Thompson of the Lancaster III.

Among the Lancaster's last offensive actions in Europe was the tactical bombing of enemy troops in support of the Normandy landings in June 1944, final operational sorties on April 25, 1945 being a daylight attack on Hitler's



Lancaster I *HK541* with 1,200 gallon saddle tank mock-up for the Far East war. (*Avro Photo.*)



Lancaster VI was the designation applied to a small number of Lancaster Is powered by four Rolls-Royce Merlin 85 or 102 engines in annular cowlings. *DV170* is illustrated. (*Rolls-Royce Photo.*)

mountain retreat at Berchtesgaden and a night raid on oil installations at Vallo, Norway. Total wartime sorties amounted to 156,000 at a very low rate of loss. On March 21, 1945 Bomber Command had 56 squadrons of Lancasters, totalling 745 aircraft in front line service, and when hostilities ended many of these and the 296 machines at O.C.U.s were put to the task of repatriating 75,000 prisoners of war.

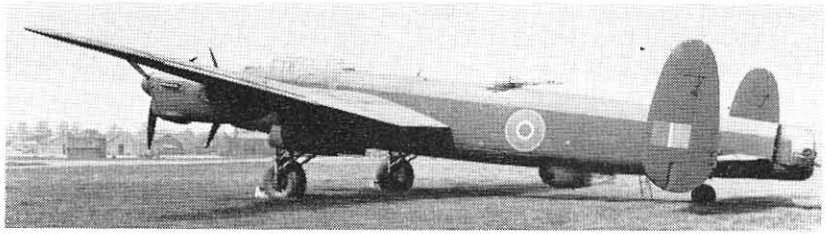
Designations Lancaster VIII and IX were never used but a considerable number of aircraft in the *SW* and *TW* series were specially equipped by Armstrong Whitworth as the Lancaster B. Mk. I (F.E.) and repainted with white upper surfaces for service with 'Tiger Force' in Burma. Made redundant by the end of the war in the Far East, many served with the peacetime R.A.F. Those of No. 35 Squadron, Graveley, made a goodwill tour of the U.S.A. July 9–August 29, 1946 and a number of others were modified for photographic reconnaissance under the designation P.R. Mk. 1. With turrets removed these formed the equipment of No. 82 Squadron which completed the aerial survey of East, Central and West Africa 1946–52.

A number of Lancasters IIIs were sent to Eastleigh, Southampton, in July 1946 to be modified for air-sea rescue duties as A.S.R. Mk. 3s equipped with airborne lifeboats. Some were further modified at a later date for maritime reconnaissance as G.R. Mk. 3s (later M.R. Mk. 3), initially with Packard Merlin 28 and 38, but when these became obsolete, with Packard Merlin 224. They served with Coastal Command and R.C.A.F. Squadrons, including Nos. 37 and 38 in Malta whose last M.R. Mk. 3, *RF273*, was flown back to England in February 1954. Another of this mark, *RF325*, withdrawn from use at the School of Maritime Reconnaissance, St. Mawgan, on October 15, 1956, was the R.A.F.'s last Lancaster. In order that this famous type should not be forgotten, Lancaster I *R5868*, veteran of 137 wartime sorties

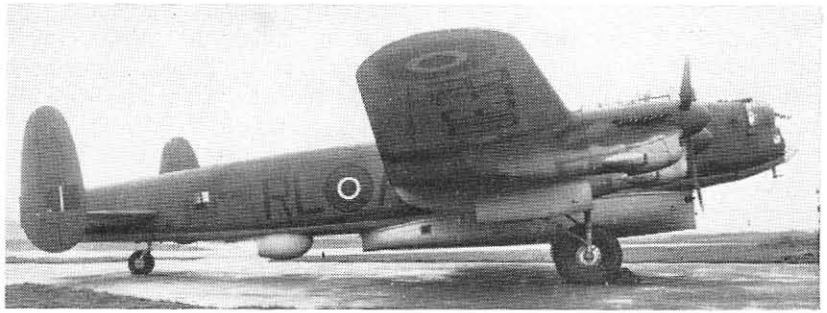
with Nos. 83 and 467 Squadrons, was then selected for preservation and mounted at the main gate of R.A.F. Scampton, its former base.

Lancaster Xs which had been flown back from Europe by No. 6 Group in June 1944 saw considerable postwar service in Canada with the R.C.A.F. in six special variants—the Lancaster 10-B bomber; 10-PR photo-reconnaissance (ten conversions for No. 408 Squadron, Rockliffe, two of which had radio altimeters for a 911,000 square mile survey of Northern Canada); 10-ASR air-sea rescue (twelve conversions 1949); 10-BR bomber reconnaissance (winterised conversions of the last four 10-ASRs plus *FM221* as prototype of the main batch converted in 1949); 10-MR maritime reconnaissance to succeed 10-BR (prototype *KB919* first flown December 29, 1950); 10-N navigation trainer (three converted); and 10-O Avro Orenda engine test bed (*FM209*). The last three R.C.A.F. Lancasters were withdrawn from service on April 1, 1964—23 years after the prototype's first flight.

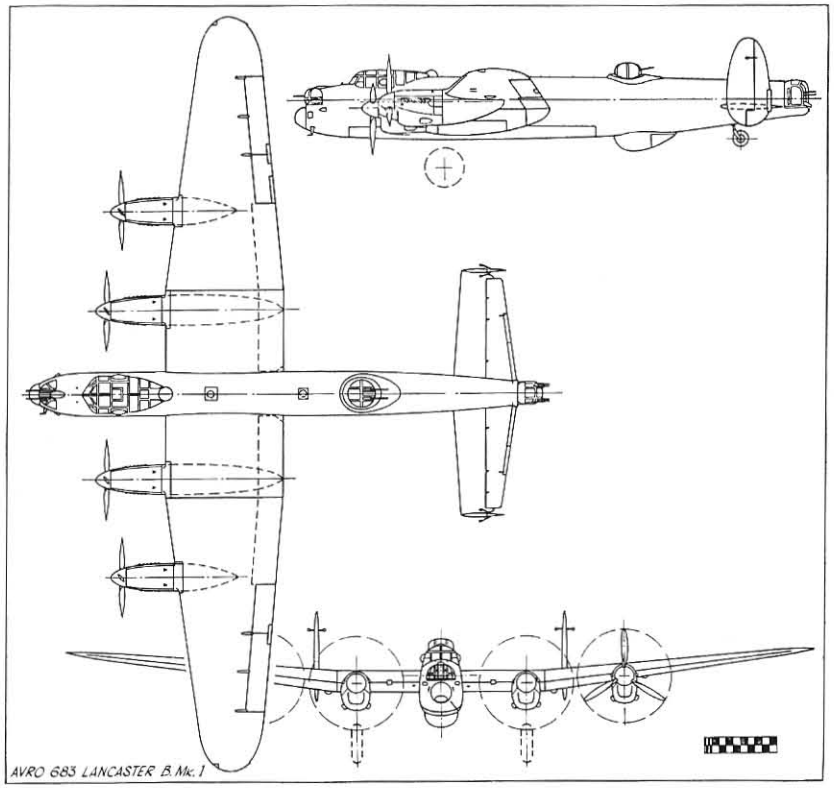
The three Lancaster 10-Ns, *FM206* "Northern Cross", *FM208* "Polaris" and *KB826* "Orion" of the R.C.A.F. Central Navigation School, made a number of training flights to the U.K. between March 1954 and June 1957, and in September 1962 the 10-ASR *FM104* again crossed the Atlantic to participate in the Battle of Britain Display at Cottesmore. As in England one R.C.A.F. Lancaster X has been preserved as a memorial, and painted to represent the famous 1942 vintage Lancaster I *VN-N* of No. 50 Squadron, R.A.F., is mounted in flying position on a concrete pillar at McCall Field,



Lancaster III *JB456* with two ·50 calibre guns in a Glenn Martin dorsal turret.



Lancaster A.S.R. Mk. III *RF310* with airborne lifeboat, December 1945. *(Crown Copyright Reserved.)*



Calgary. Another, *KB944*, is stored along with the R.C.A.F.'s Anson V. *W4783* "George", veteran of 90 operations over Germany, and flown to Australia in 1944, was later allotted R.A.A.F. serial *A66-2* and is preserved in the Australian War Museum at Canberra. *A66-1*, only other Lancaster with R.A.A.F. marks, and formerly *ED930* "Queenie VI", was flown out by the same route in the previous year by F/Lt. P. S. Isaacson and an Australian crew. It arrived at Sydney on June 4, 1943 and flew nonstop from Melbourne to Ohakea, New Zealand, in 7 hr. 39 min. on June 11.

War surplus Lancasters found a ready market among foreign powers and A. V. Roe and Co. Ltd. overhauled 15 Metro-Vick machines which were flown to Buenos Aires to equip Air Regiment No. 1 (Bomber), Argentine Air Force. In March 1952 fifty-four Mks. 1 and 7 were also reconditioned at Woodford and Langar, Notts., for the French Aéronavale. Dorsal turrets were removed, ventral ASV radar installed; and long range tanks, extra rear windows and lifeboat pick-up points were fitted. With Western Union serials commencing *WU01*, they went into French overseas service with Nos. 24F (Laun-Bihoue) and 25F Squadrons for maritime reconnaissance from bases

in North Africa to assist R.A.F. Coastal Command in protecting Atlantic shipping. Others served with Nos. 9S and 10S Squadrons of the 95th Flotille, Tontouta, New Caledonia. Five additional Austin-built Lancaster VIIs supplied in December 1953 for special duties were serialled *FCL.01* to *'05*.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; Woodford Aerodrome, Cheshire; and Yeadon Aerodrome, Yorks.
Sir W. G. Armstrong Whitworth Aircraft Ltd., Whitley Aerodrome, Coventry and (from 1945) Bitteswell Aerodrome, Warwicks.
Austin Motors Ltd., Longbridge Works, Birmingham
Metropolitan-Vickers Ltd., Mosley Road Works, Manchester
Vickers-Armstrongs Ltd., Castle Bromwich Aerodrome, Birmingham; and Hawarden Aerodrome, Chester
Victory Aircraft Ltd., Malton, Ontario, Canada

Power Plants:
(Prototypes) Four 1,145 h.p. Rolls-Royce Merlin X
(Lancaster I) Four 1,280 h.p. Rolls-Royce Merlin XX, 22 or 24
(Lancaster B. Mk. I Special) Four 1,280 h.p. Rolls-Royce Merlin 22 or 24
(Lancaster II) Four 1,650 h.p. Bristol Hercules VI or XVI
(Lancaster III) Four 1,300 h.p. Packard Merlin 28; 1,480 h.p. Merlin 38; or 1,640 h.p. Merlin 224
(Lancaster VI) Four 1,750 h.p. Rolls-Royce Merlin 85 or 102
(Lancaster VII) Four 1,620 h.p. Rolls-Royce Merlin 24
(Lancaster X) Four 1,300 h.p. Packard Merlin 28; 1,480 h.p. Merlin 38; or 1,640 h.p. Merlin 224

Dimensions: Span 102 ft. 0 in. Length 69 ft. 4 in.
Height 20 ft. 6 in. Wing area 1,297 sq. ft.

Weights:
(Lancaster I, III and X) Tare weight 36,457 lb. All-up weight 50,000 lb.*
(Lancaster VII) All-up weight 68,000 lb.
*Range 1,550 miles with 22,000 lb. (10 ton) bomb at a take-off weight of 72,000 lb.

Performances:
(Lancaster I, III and X)
Maximum speed 287 m.p.h.
Cruising speed 200 m.p.h.
Initial climb 250 ft./min. Ceiling 19,000 ft.
Maximum range 2,530 miles
(Lancaster II) Maximum speed 270 m.p.h.
(Lancaster VII) Maximum speed 275 m.p.h. Maximum range (for Aéronavale long range conversions) 3,800 miles

Production:
Three Avro-built prototypes *BT308*, *DG585* and *DT810* ordered to Contract No. B135521/40, followed by 7,374 production aircraft as follows: A. V. Roe and Co. Ltd. 3,670; Sir W. G. Armstrong Whitworth Aircraft Ltd. 1,329; Austin Motors Ltd. 330; Metropolitan-Vickers Ltd. 1,080; Vickers-Armstrongs Ltd. 535; Victory Aircraft Ltd. 430

(*a*) **By A. V. Roe and Co. Ltd.**

(i) 1,070 aircraft ordered 1940 to Air Ministry Specification under Contract No. B69274/40, and built at Manchester to Works Order No. 7671: (Lancaster B. Mk. I) *L7527–L7549*, *L7565–L7584*, *R5482–R5517*, *R5537–R5576*, *R5603–R5640*, *R5658–R5703*, *R5724–R5763*, *W4102–W4140*, *W4154–W4201*, *W4230–W4279*, *W4301–W4340*, *W4355–W4384*, *ED303–ED334*. (Lancaster B. Mk. I and III) *ED347–ED396*, *ED408–ED453*, *ED467–ED504*, *ED520–ED569*, *ED583–ED631*, *ED645–ED668*, *ED688–ED737*, *ED749–ED786*. (Lancaster B. Mk. III) *ED799–ED842*, *ED856–ED888*, *ED904–ED953*, *ED967–ED999*, *EE105–EE150*, *EE166–EE202*

(ii) 2,050 Lancaster B. Mks. I and III ordered 1941 to Air Ministry Specification under Contract No. 1807 and built at Manchester and Yeadon to Works Order No. 8545: *JA672–JA718*, *JA843–JA876*, *JA892–JA941*, *JA957–JA981*, *JB113–JB155*, *JB174–JB191*, *JB216–JB243*, *JB275–JB320*, *JB344–JB376*, *JB398–JB424*, *JB453–JB488*, *JB526–JB567*, *JB592–JB614*, *JB637–JB684*, *JB699–JB748*, *ND324–ND368*, *ND380–ND425*, *ND438–ND479*, *ND492–ND538*, *ND551–ND597*, *ND613–ND658*, *ND671–ND715*, *ND727–ND768*, *ND781–ND826*, *ND839–ND882*, *ND895–ND936*, *ND948–ND996*, *NE112–NE151*, *NE163–NE181*, *PA964–PA999*, *PB112–PB158*, *PB171–PB213*, *PB226–PB267*, *PB280–PB308*, *PB341–PB385*, *PB397–PB438*, *PB450–PB490*, *PB504–PB542*, *PB554–PB596*, *PB609–PB653*, *PB666–PB708*, *PB721–PB768*, *PB780–PB823*, *PB836–PB881*, *PB893–PB936*, *PB949–PB998*, *PD112–PD139*, *RE115–RE140*, *RE153–RE188*, *RE200–RE222*, *RE225–RE226*, *SW319–SW345*, *SW358–SW377*, *TX263–TX273* (*RE115–TX273* built at Yeadon; *PB780–PB936* all B. Mk. I; *PD112–PD139* delivered as B. Mk. I (Special); *PB579* crashed on test flight 11.9.44 and erased from Contract, Avro test pilot S. H. Gleave killed)

(iii) 550 Lancaster B. Mks. I and III ordered 1942 to Air Ministry Specification under Contract No. 2010 and built at Yeadon to Works Order No. 8589: *LM301–LM346*, *LM359–LM395*, *LM417–LM448*, *LM450–LM493*, *LM508–LM552*, *LM569–LM599*, *LM615–LM658*, *LM671–LM697*, *LM713–LM756*, *ME295–ME337*, *ME350–ME395*, *ME417–ME458*, *ME470–ME503*, *ME517–ME551*

(*b*) **By Sir W. G. Armstrong Whitworth Aircraft Ltd.**

(i) 910 Lancaster B. Mk. I aircraft ordered 1941 to Air Ministry Specification under Contract No. 239/SAS/C4(C) and built at Whitley, Coventry 1943: *LL740–LL758*, *LL771–LL813*, *LL826–LL867*, *LL880–LL923*, *LL935–LL977*, *LM100–LM142*, *LM156–LM192*, *LM205–LM243*, *LM257–LM296*, *NF906–NF939*, *NF952–NF999*, *NG113–NG149*, *NG162–NG206*, *NG218–NG259*, *NG263–NG308*, *NG321–*

NG367, NG379–NG421, NG434–NG469, NG482–NG503, RF120–RF161, RF175–RF197, SW297–SW316, TW647–TW671, TW858–TW873, TW878–TW911

(ii) 300 Lancaster B. Mk. II aircraft ordered 1941 to Air Ministry Specification under Contract No. 239/SAS/C4(C) and built at Whitley, Coventry 1942–43: *DS601–DS692, DS704–DS741, DS757–DS797, DS813–DS852, LL617–LL653, LL666–LL704, LL716–LL739*

(iii) 119 Lancaster B. Mk. I and III aircraft ordered 1941 to Air Ministry Specification under Contract No. 239/SAS/C4(C) and built at Whitley Coventry 1945: *RF198–RF216, RF229–RF273, RF286–RF326, SW283–SW296*

(*c*) **By Austin Motors Ltd.**

(i) 150 Lancaster B. Mk. I aircraft ordered 1942 to Air Ministry Specification under Contract No. 2827 and built at Longbridge Works, Birmingham: *NN694–NN726, NN739–NN786, NN798–NN816, NX548–NX589, NX603–NX610*

(ii) 180 Lancaster B. Mk. VII aircraft ordered 1942 to Air Ministry Specification under Contract No. 2827 and built at the Longbridge Works, Birmingham: *NX611–NX648, NX661–NX703, NX715–NX758, NX770–NX794, RT670–RT699*

(*d*) **By Metropolitan-Vickers Ltd.**

(i) 57 Lancaster B. Mk. I aircraft originally ordered as Manchesters under Contract No. B982866/40, built at the Mosley Road Works, Manchester: *R5842–R5868, R5888–R5917*

(ii) 400 Lancaster B. Mk. I and III aircraft ordered 1940 to Air Ministry Specification under Contract No. B69275/40 and built at the Mosley Road Works: *W4761–W4800, W4815–W4864, W4879–W4905, W4918–W4967, W4980–W5012, DV155–DV202, DV217–DV247, DV263–DV312, DV324–DV345, DV359–DV407*

(iii) 487 Lancaster B. Mk. I aircraft ordered 1941 to Air Ministry Specification under Contract No. 2221 and built at the Mosley Road Works: *ME554–ME596, ME613–ME650, ME663–ME704, ME717–ME759, ME773–ME814, ME827–ME868, PD198–PD239, PD252–PD296, PD309–PD349, PD361–PD404, PD417–PD444, SW243–SW279*

(iv) 136 Lancaster B. Mk. I aircraft ordered 1941 to Air Ministry Specification under Contract No. 2221 and built at the Mosley Road Works: *RA500–RA547, RA560–RA607, RA623–RA627, RA787–RA806, TW915–TW929*

(*e*) **By Vickers-Armstrongs Ltd.**

(i) 200 Lancaster B. Mk. I aircraft originally ordered 30.9.41 as B. Mk. IIs, built at Castle Bromwich 1943–44 under Contract No. 1336: *HK535–HK579, HK593–HK628, HK644–HK664, HK679–HK710, HK728–HK773, HK787–HK806*

(ii) 200 Lancaster B. Mk. I aircraft ordered 17.7.43 and built at Castle Bromwich under Contract No. 1336: (100 built) *PP663–PP695, PP713–PP758, PP772–PP792.* (100 cancelled) *PP793–PP806, PP820–PP866, PP880–PP918*

(iii) 235 Lancaster B. Mk. I aircraft ordered 1943 under Contract No. 2791 and built at Chester: *PA158–PA198, PA214–PA239, PA252–PA288, PA303–PA351, PA365–PA396, PA410–PA452, PA473–PA478* and *PA509*

(iv) 100 Lancaster B. Mks. IV and V ordered 17.12.43 and a further 150 ordered 6.44: *SR707–SR749, SR766–SR790, SR814–SR851, SR864–SR907* (Contract cancelled 12.44 and aircraft not built)

(*f*) **By Victory Aircraft Ltd.**

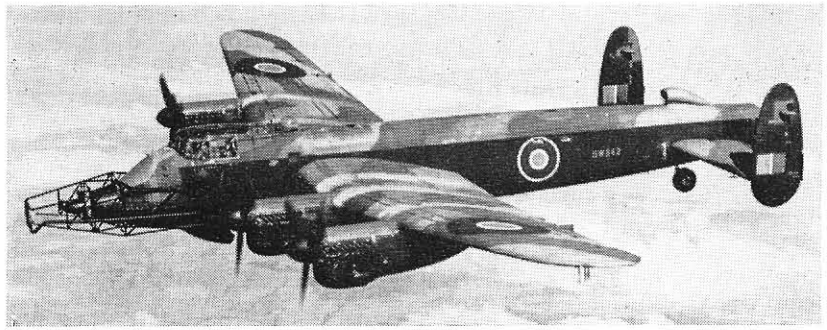
430 Lancaster B. Mk. X aircraft ordered 1942 and built at Malton, Ontario, Canada: *KB700–KB999, FM100–FM229*

(*g*) **Reconditioned by A. V. Roe and Co. Ltd.**

Fifteen Metro-Vick aircraft for the Argentine to Works Order SALES 106: *B-031* to *B-045*, c/n 1450–1464, test flown as *G-11-14* to *G-11-28*, ex *PA375, 376, 377, 350, 348, 349, 344, 369, 346, 365, RA625, 798, 788, 789* and *PA378*. Nine Lancaster B. Mk. III for Egypt 1950 converted at Bracebridge Heath to Works Order 1054: *1801–1809*, c/n 1510–1518, test flown as *G-11-60* to *G-11-68*, ex *PA476, 441, SW308, TW893, PA435, 391, TW890, SW313* and *TW656*. Five Lancaster B. Mk. VII for France 12.53 to Works Order 1670: *FCL.01* to *FCL.05*, c/n 1521–1525, ex *RT693, NX738, RT689, 673, 679* and *693*, believed test flown as *G-11-69* to *G-11-73*

Service Use:

Lancaster B. Mk. I: Nos. 7, 9, 12, 15, 35, 44, 49, 50, 57, 61, 70, 75, 82, 83, 90, 97, 100, 101, 103, 104, 106, 115, 138, 148, 149, 150, 153, 156, 166, 167 (VL), 170, 178, 186, 189, 195, 207, 210, 218, 227, 262, 300, 405, 407, 408, 419, 424, 427, 429, 433, 434, 460, 463, 466, 467, 514, 550, 576, 582, 617, 622, 625, 626, 627, 630, 635 and 683 Squadrons; No. 1677 Flight (HM); Bomb Ballistics Unit (OR); Radio Warfare Establishment (V7). Lancaster B. Mk. I (F.E.): Nos. 7, 9, 35, 49, 90, 115, 138, 148 (AU), 149, 207, 214 (QN) and 425 Squadrons; No. 230 O.C.U. (A3); Central Bombing Establishment (DF); Central Gunnery School (FJS); Empire Air Navigation School (FGE); Empire Flying School (FCX); Radio Warfare Establishment (4S). Lancaster B. Mk. I (Special): Nos. 15 and 617 Squadrons. Lancaster B. Mk. II: Nos. 61, 115, 408, 432, 514 and 627 Squadrons; Nos. 1651, 1653–1656, 1659–1662, 1665–1668 H.C.U. Lancaster B. Mk. III: Nos. 7, 9, 12, 15, 21, 35, 44, 49, 50, 57, 61, 75, 83, 90, 97, 100, 101, 103, 106, 115, 138, 148, 149, 150, 153, 156, 166, 170, 189, 195, 203, 207, 218, 227, 231, 262, 300, 405, 419, 420, 424, 426, 427, 429, 431, 432, 433, 460, 462, 466, 467, 514, 550, 576, 582, 617, 619, 621 and 622 Squadrons; Bomber Command Instructors' School (WB); Empire Air Armament School (FGA); Empire Flying School (FCX); Nos. 1, 3, 5 and 6 L.F.S. Lancaster B. Mk. III (Special): No. 405 Squadron. Lancaster ASR Mk. III: Nos. 37, 179 (OZ) and 203 Squadrons. Lancaster GR Mk. III: Nos. 18, 120 (BS), 179 (OZ), 203 (CJ) and 621 Squadrons. Lancaster MR Mk. III: Nos. 37, 38 (RL), 201 (OZ), 224 (XB), 404, 405 and 408 Squadrons; Air-Sea Warfare Development Unit (P9); No. 1 School of Maritime Reconnaissance; Nos. 6, 111 and 132 O.T.U. (K7); No. 236 O.C.U. (K7). Lancaster B. Mk. VI: No. 635 Squadron. Lancaster B. Mk. VII: Nos. 9, 35, 40, 57, 104 (EP), 214 (QN), 427, 460 and 617 Squadrons. Lancaster B. Mk. VII (F.E.): Central Flying School (FDI); Empire Air Armament School (FGC); Empire Air Navigation School (FGG); Empire Flying School (FCX); Station Flight, Scampton (YF); No. 20 M.U. (QX). Lancaster MR Mk. X: Nos. 61, 101, 115, 404, 405, 407, 420, 424, 425, 428, 431 and 434 Squadrons; No. 2 M.O.T.U. Lancaster PR Mk. X: Nos. 408, 413 and 419 Squadrons.



Lancaster III *SW342* with Armstrong Siddeley Mamba turboprop in a nose mounted icing rig, and Adder turbojet in the tail. (*Armstrong Siddeley Photo.*)

Avro 683 Lancaster (civil and experimental)

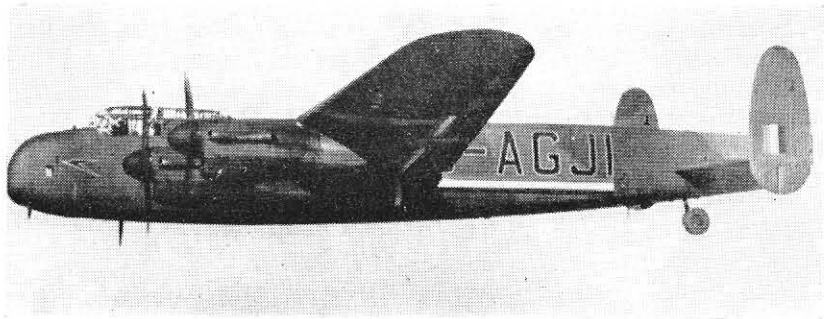
With armament removed, the war surplus Lancaster made an ideal test vehicle and was used in some numbers by aircraft and engine manufacturers bent on perfecting new equipment and new engines for postwar civil and military use. The first, *G-AGJI*, was delivered to the B.O.A.C. Development Flight at Hurn on January 20, 1944 and with neat fairings replacing front and rear turrets (but initially retaining wartime camouflage), was first used for developing equipment for new postwar transport aircraft. Later the Merlin 22s gave place to Merlin 102s with annular radiators for test under operating conditions prior to their installation in the new Avro 688 Tudor Is. In this form *G-AGJI* was equivalent to one version of the Lancaster VI.

Four of the six Lancaster Is acquired by the British South American Airways Corporation from the Ministry of Supply in 1946 were converted into freighters by A. V. Roe and Co. Ltd. at Bracebridge Heath, Lincoln, and fitted with elongated noses of the type employed on the Avro 691 Lancastrian, but the tail turrets were merely silvered over. They proved uneconomic in operation and were pensioned off after only a year, their main task having been the transport of perishable goods and South American cotton samples. Airtech Ltd. of Thame acquired one of them (*G-AGUM*) for the trial installation of an outsize ventral pannier intended for carrying vehicles or other awkward loads on the Berlin Air Lift. One of B.S.A.A.'s two unconverted Lancasters went to the B.O.A.C. Development Flight in September 1946 as *G-AHVN* to continue the test programmes initiated by *G-AGJI*.

Four Lancaster IIIs released to Flight Refuelling Ltd. in August 1946 were converted at Staverton into two pairs of tanker and receiver aircraft with bulk storage tanks and power driven hose reels. Registered *G-AHJT* to *'JW*, they went to Ford (and later Tarrant Rushton) to assist in perfecting the company's airborne refuelling techniques, earlier developed with Lancaster

IIIs *NE147*, *ND648* and *PP992*. The last two of these were flown after the war under B conditions as *G-33-1* and *2* respectively. The commercial application of this system was demonstrated in co-operation with B.S.A.A. on 22 trans-Atlantic flights during the period May–August 1947. Flown by Air Vice-Marshal D. C. T. Bennett, the first service left London on May 28, 1947, refuelling in mid-Atlantic from an Azores-based Lancaster tanker, and completed the 3,355 mile flight to Bermuda nonstop. In 1948 the two tanker aircraft *G-AHJU* and *'JW*, plus *'VN* acquired from B.O.A.C., were flown to Germany for a year's service on the Berlin Air Lift during which they completed 757 sorties.

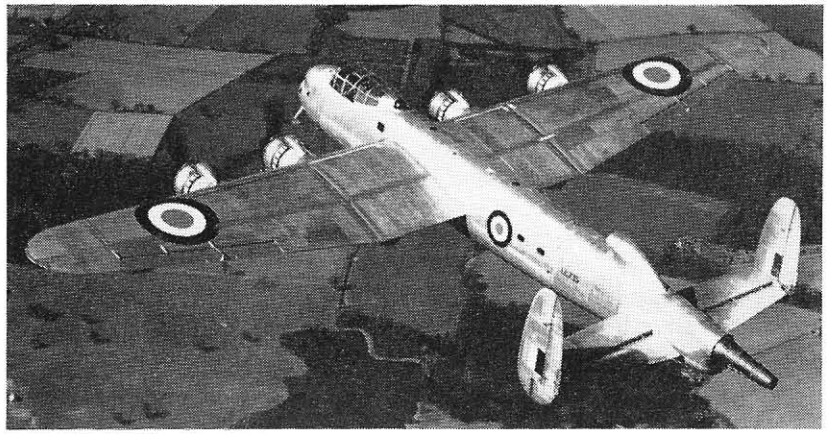
Seven other Lancasters were allotted British civil marks but with two exceptions were broken up for spares. The first, a camouflaged B. Mk. I (Special), arrived at White Waltham in July 1947 and a month later was flown to Italy as *G-AJWM* under British European Airways ownership as a trainer for Alitalia Lancastrian crews. The other aircraft, Lancaster I *G-AKAB* "Sky Trainer", was used for the same purpose by Skyways Ltd. at Dunsfold. Surplus R.C.A.F. Lancaster Xs were also used for survey work in Canada by Spartan Air Services of Ottawa as *CF-IMF* and *'MG*, and the famous



Lancaster I test bed *G-AGJI* in its original form with Merlin 22 engines.



Lancaster Freighter *G-AGUL* "Star Watch" of British South American Airways Corporation being loaded at London Airport in 1946. (*'The Aeroplane' Photo.*)



Lancaster II *LL735* flying with Metro-Vick Beryl gas turbine engine mounted in the tail. (*Charles E. Brown Photo.*)

"Polaris" *FM208* was acquired by World Wide Airways Inc. of Dorval as *CF-KHH*.

In normal civil use the Lancaster was powered by four 1,640 h.p. Rolls-Royce Merlin T.24 engines as used in the Avro 685 York.

In addition to important contributions to the reshaping of air transport in the years immediately after the Second World War, the Lancaster also served as flying test bed for final marks of the historic Merlin engine; for the new generation of gas turbine engines; and for aerodynamic research. Three aircraft employed at Filton for flight testing control systems for the eight engined Bristol Type 167 Brabazon 1 in 1945–46 were Lancaster I *PP745* (power operated elevators); Lancaster II *DS708* (servo controls); and Lancaster III *RE131* (scaled down version of the entire Brabazon control system). Lancaster I *PA474*, transferred to the College of Aeronautics, Cranfield, on its retirement from No. 82 Squadron in 1954, and used initially as a flying laboratory with aerofoil sections mounted vertically on top of the fuselage, flew at Cranfield on October 2, 1962 with a section of laminar flow wing for the Handley Page H.P. 117 in the test rig. Lancaster III *ME540* was fitted by Boulton Paul Ltd. with a gust alleviation device in the nose in 1951–52.

Three other Lancasters played a key role in postwar navigation, signals and armament development. Most famous of these was Lancaster I *PD328* (named "Aries"), delivered to the Empire Air Navigation School, Shawbury, in 1944 for long range navigation liaison flights. In nine 24 hour working days, Avro's aircraft repair depot at Waddington, Lincs., stripped and polished it, fitted Lancastrian nose and tail sections, a Lincoln undercarriage, and extra fuel tanks in nose and bomb bay. Powered by four 1,280 h.p. Rolls-Royce Merlin 24s, captained by Wing Cdr. D. C. McKinley D.F.C., and carrying over a ton of the newest navigational aids, it had the

distinction of being the first British service aeroplane to circumnavigate the earth when it flew to Auckland, New Zealand, via Montreal and San Francisco and back via Australia, Ceylon, Aden, Cairo and Malta. This 41,454 mile flight was completed on December 14, 1944.

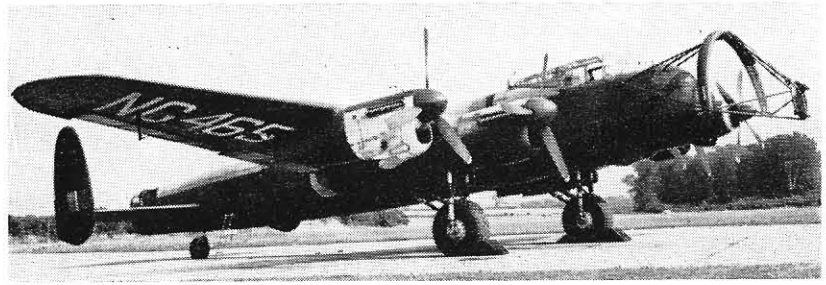
After special arctic modifications it was flown to Iceland on May 16, 1945 to make a series of research flights over the North Geographic and Magnetic Poles to confirm true positions calculated by the Astronomer Royal, and to help in the development of the Greenwich Grid system of polar navigation. The homeward trip was made by Wing Cdr. McKinley nonstop from Whitehorse, Yukon, to Shawbury over the Magnetic Pole on May 25–26.

Piloted by Sq. Ldr. A. A. Imrie, "Aries" flew 4,076 miles nonstop from Prestwick to Rivers, Manitoba, on June 7 on a liaison visit to the Canadian Central Navigation School; flew to the Mediterranean in September; and in January 1946 Wing Cdr. C. M. Dunnicliffe D.S.O., D.F.C. used it for the first Cairo–Cape Town nonstop flight and reduced the England–Cape record to 32 hr. 21 min. A second tour to the Pacific which commenced at Blackbushe on August 22 that year with Sq. Ldr. J. E. Aldridge as captain, lasted six weeks and covered much the same route as in 1944. Three F.A.I. point-to-point records were established:

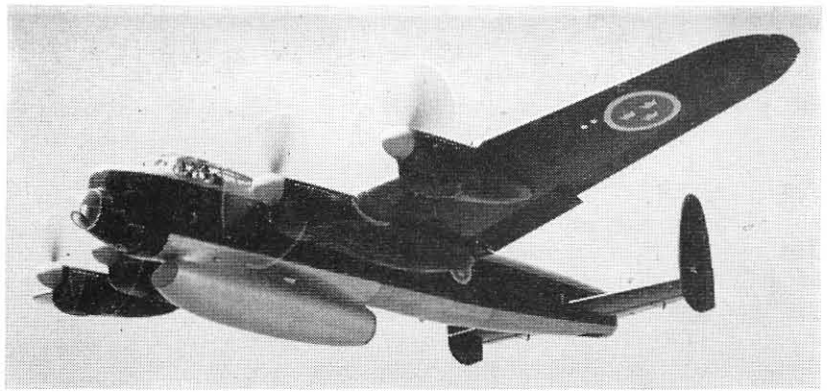
London–Karachi	3,945 miles in 19 hr. 14 min.
London–Darwin	8,639 miles in 45 hr. 35 min.
London–Wellington, N.Z.	11,647 miles in 59 hr. 50 min.

Her final mission, begun on October 24, 1946, was a three week, 12,000 mile tour through Canada and the U.S.A., and in February 1947 "Aries" was withdrawn from use after covering 200,000 miles on major flights alone.

"Iris" was a Lancaster I (F.E.) equipped at the Central Signals Establishment, Watton, with the fullest possible range of radio and radar aids (including Rebecca, Babs, Loran, Gee, radio altimeter and compass, S.B.A., etc.) for the calibration and regular checking of radio and radar services in Home and Overseas Commands. In this connection the aircraft made an extensive tour of Africa and the Near East in August 1948. *PB875* "Thor" fulfilled a similar function at the Empire Air Armament School, Manby,



Lancaster III *NG465* with Rolls-Royce Dart turboprop engine in a nose icing rig. (*Rolls-Royce Photo.*)



Swedish Air Force Lancaster *80001*, c/n 1520, equipped at Hamble as test bed for the Stal Dovern turbojet. (*Hawker Siddeley Photo.*)

where it was fitted with the newest blind bombing and gunnery devices. Captained by Wing Cdr. M. H. de L. Everest, it left on an armament demonstration mission to Australia and New Zealand on March 25, 1946.

Noteworthy on account of Lincoln-type rudders and the absence of ventral radar blister, dorsal and tail turrets, the former No. 617 Sqn. Lancaster B. Mk. VII *NX739* was maintained by Eagle Aviation Ltd. at Blackbushe for several years on behalf of the Ministry of Supply as a photographic aircraft for 'shooting' fast new types being test flown at Farnborough. It was dismantled in 1957.

SPECIFICATION AND DATA

Manufacturers, power plants, dimensions, weights and performances are given in full on page 346.

Civil conversions:

(*a*) **In the United Kingdom**

DV379/G-AGJI, C. of A. 12.1.44, B.O.A.C. Development Flight, broken up at No. 39 M.U., Colerne 12.47; *PP689/G-AGUJ*, 12.3.46, B.S.A.A.C. "Star Pilot", dismantled at Langley 1949; *PP688/G-AGUK*, 30.1.46, B.S.A.A.C. "Star Gold", reduced to spares at Langley 1947; *PP690/G-AGUL*, 1.4.46, B.S.A.A.C. "Star Watch", crashed at London Airport 23.10.47; *PP751/G-AGUM*, 6.5.46, B.S.A.A.C. "Star Ward", to B.O.A.C. 9.49, dismantled at Dunsfold 12.49; *PP744/G-AGUN*, civilianised 7.46 as *G-AHVN* for the B.O.A.C. Development Flight, to Flight Refuelling Ltd. 3.49, scrapped at Tarrant Rushton 1.50; *PP746/G-AGUO*, returned to the R.A.F. before conversion; *LL809/G-AHJT*, 13.5.46, Flight Refuelling Ltd. tanker aircraft, scrapped at Tarrant Rushton 1.50 with receiver *LM681/G-AHJU* and receiver *LM639/G-AHJV*; *ED866/G-AHJW*, 13.5.46, Flight Refuelling Ltd. tanker, crashed near Andover 22.11.48; *PP741/G-AJWM*, 19.7.48, sold to Alitalia by

B.E.A.C. 30.11.48; *PP739/G-AKAB*, 10.10.47, Skyways Ltd. "Sky Trainer", scrapped at Dunsfold 11.48

Note: HK557, *PP743*, *PP742* and *PP734* were obtained by Flight Refuelling Ltd. 6.47 and flown to Tarrant Rushton as *G-AKAJ–'AM* to be used as spares. *NX726*, a Lancaster VII which had been allotted marking *G-ALVC*, was reduced to spares for the Yorks of Eagle Aviation Ltd. at Luton 1.50

(*b*) **In Canada**

FM222/CF-IMF, Mk. 10ASR ex No. 103 R.U., Greenwood, N.S., disposed of to Spartan Air Services Ltd. 16.3.56, permit for ferrying Camp Borden–Ottawa 19.3.56, restricted C. of A. 7.6.56, s.o.r. 29.12.59; *KB907/CF-IMG* and *KB909/CF-IMH*, Mk. 10ASR ex Eastern Air Command, to Spartan 16.3.56, ferrying permits Camp Borden–Ottawa 19.3.56 and 26.3.56 respectively, conversion not proceeded with; *FM208/CF-KHH*, Mk. 10N ex Maritime Air Command, Summerside, P.E.I., to Ajax Aircraft Ltd., Toronto 28.5.57, to World Wide Airways Inc. and equipped for bulk transport of diesel fuel, last reported Dorval 7.60

Engine test beds:

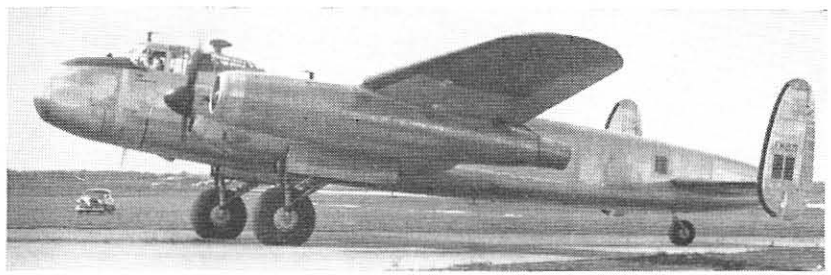
R5849 Lancaster I To Rolls-Royce Ltd., Hucknall; flown with four 1,770 h.p. Merlin 600 engines in annular cowlings

BT308 Prototype To Rolls-Royce Ltd., Hucknall 28.2.42; flown with Metropolitan-Vickers F.2 axial flow gas turbine in the rear fuselage with large air intake above it; s.o.c. at R.A.E. Farnborough 30.5.44

JB675 Lancaster III To Rolls-Royce Ltd., Hucknall; flown with two 1,770 h.p. Merlin 621 for the Avro Tudor I inboard, and two 1,760 h.p. Merlin 620 for the Canadair C-4 outboard

LL735 Lancaster II To Metropolitan-Vickers Ltd. to replace *BT308*; first flown with F.2/1 gas turbine in the tail 29.6.43. Flew with 3,500 lb. s.t. F.2/4 Beryl in the tail 1945

ND784 Lancaster VI To Power Jets Ltd.; equipped for mounting a variety of test engines in the bomb bay and known as the 'Lancaster Universal Test Bed'. Flown at the R.A.E. 4.43 with four Merlin XXs and one 2,600 lb. s.t. Armstrong Siddeley ASX in the bomb bay; later with four 1,750 h.p. Merlin 85s in annular cowlings and one Armstrong Siddeley Mamba in the nose



The Lancaster X Avro Orenda test bed *FM209*.

NG465 Lancaster III To Rolls-Royce Ltd., Hucknall 8.46; first flown by R. T. Shepherd 10.10.47 with 1,000 h.p. + 325 lb. s.t. Dart test engine No. 5 in the nose; two 100 gallon water tanks later installed in the rear fuselage for water droplet artificial icing flight programme; flown 3.49 with Dart No. 15; 2.51 with Dart No. 3; and 1.53 with Dart No. 30; destroyed in forced landing at Holinwell Golf Course, Mansfield 22.1.54

PP791 Lancaster III To Rolls-Royce Ltd., Hucknall; flown with four 1,770 h.p. Merlin 600

RE137 Lancaster III To Armstrong Siddeley Motors Ltd., Baginton 1947; flown with two 3,670 h.p. Python turboprop engines driving eight bladed contra-rotating airscrews outboard

SW342 Lancaster III Modified by Air Service Training Ltd., Hamble 1.49 to take a nose-mounted Armstrong Siddeley Mamba turboprop; delivered to Bitteswell for icing tests. Flown 5.52 with four 1,640 h.p. Merlin 24s, Mamba driving a cropped airscrew inside the icing rig, and Adder turbojet in the tail for scale after-burning tests, dismantled 8.56

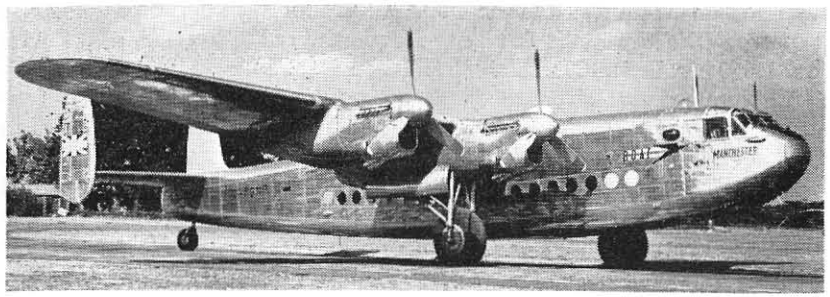
TW911 Lancaster III To Armstrong Siddeley Motors Ltd.; first flown at Bitteswell 3.1.49 with two 1,610 h.p. Merlin 24s inboard and two 3,670 h.p. Python I turboprops outboard. A 400 gallon extra fuel tank was fitted in the bomb bay and the wing trailing edge was extended rearwards as far as the outer nacelles

80001 Lancaster Equipped as a test bed for the Royal Swedish Air Force by Air Service Training Ltd., Hamble to Avro Works Order 1080, c/n 1520, and first flown 24.4.51. Fitted in Sweden with one 7,360 lb. s.t. Stal Dovern turbojet in a ventral pod; later air tested reheat Ghost for Saab J 29; crashed 8.5.56

FM205 Lancaster X Converted by A. V. Roe (Canada) Ltd. as test bed for two 3,000 lb. s.t. Avro Chinook T.R.4 Mk. II axial flow engines in the outer nacelles

FM209 Lancaster X Converted as above for air testing Avro Orenda axial flow engines in the outer nacelles

KB848 Lancaster X R.C.A.F. trials with Ryan Firebee missiles mounted under wing tips



Avro 685 York C.1 *G-AGNP* "Manchester" in its original B.O.A.C. blue, gold and polished metal livery. (*B.O.A.C. Photo.*)

Avro 685 York

To exploit more fully the Lancaster's long distance load carrying capability while retaining its fine handling qualities, designer Roy Chadwick conceived the idea of a pure transport version which used the same mainplane, power units, undercarriage and tail assembly. He therefore designed an all-metal, square section fuselage having twice the cubic capacity of the original, and despite the project being a private venture, had the prototype (christened York) in the air for the first time at Ringway on July 5, 1942—just five months after the drawings were issued to Avro's experimental department.

The agreement between Britain and the U.S.A. whereby the latter should produce all wartime transport aircraft, made it impossible to sanction materials or labour for the York. Nevertheless the successful result of trials with the camouflaged prototype *LV626* at Boscombe Down in August 1942 led to a contract for three further prototypes and a limited number of production York C. Mk. 1s to Air Ministry Specification 1/42. Whereas the first prototype *LV626* was an unfurnished freighter, the second, *LV629*, completed with full complement of passenger seats, was based at Woodford until broken up there in 1948. The third prototype, *LV633* "Ascalon" which had square instead of round windows, was delivered to No. 24 Squadron, Northolt, as a flying conference room for Mr. (later Sir) Winston Churchill but a reservation for civil registration *G-AGFT*, believed for this aircraft, was not taken up. The fourth York, *LV639*, fitted with dropping doors in the floor and evaluated by the A.F.E.E., Ringway, as a paratroop transport, was found unsuitable due to slipstream wash along the fuselage. "Ascalon", posted to the Far East Communication Flight at Changi, Singapore, in 1946, was later replaced by *MW295* "Ascalon II" which paid an official visit to New Zealand in February 1957.

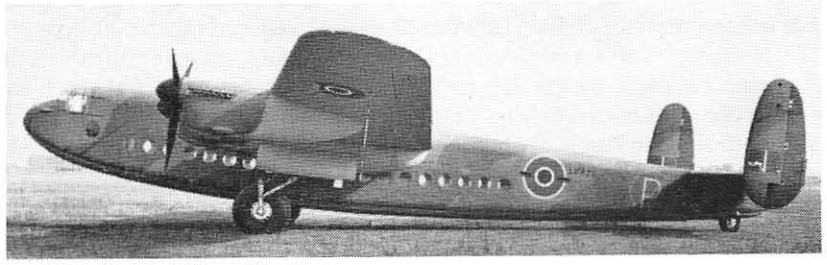
First and second prototypes had twin fins and rudders as on the Lancaster but subsequent prototypes and all production aircraft (known in the R.A.F. as the York C. Mk. 1) had a third central fin to compensate for increased

fuselage side area forward of the C.G. A third fin was fitted later to the first prototype *LV626* when it flew as the first—and only—York C. Mk. 2 with four 1,650 h.p. Bristol Hercules VI radials.

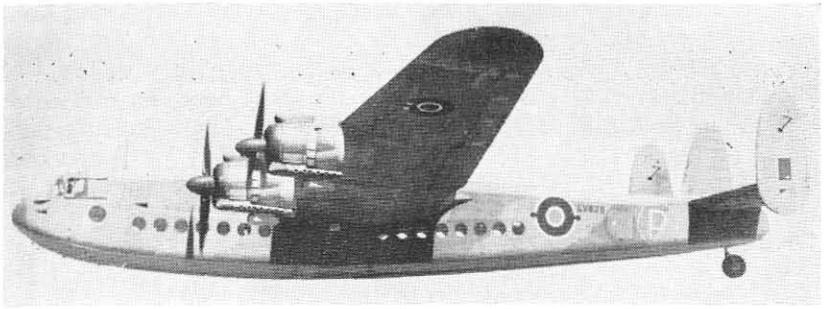
Absolute priority given to Lancaster production resulted in the construction of only three Yorks in 1943. This increased to three per month in 1944 but its designer did not live to see it in large scale production in 1945–48. Most early examples were V.I.P. transports, the first two *MW100* and *MW101* (also with No. 24 Squadron), alone covered more than half a million miles carrying Cabinet Ministers and high ranking officers to wartime conferences at Cairo, Teheran, Yalta and Moscow, as well as on other official business. The Prime Ministerial "Ascalon" conveyed Churchill and numerous Allied commanders Northolt–Gibraltar–Algiers on May 25, 1943 and was used soon afterwards by King George VI on his tour of Service units in North Africa and the Mediterranean area. On posting, its duties were taken over by *MW100* which, together with *MW104*, was eventually disposed of as spares in 1953. They were then given civil marks *G-ANAA* and *'AB* and flown (*'AA* without the central fin) to Stansted to be broken up as spares. *MW107*, personal transport of Field-Marshal Smuts, transferred to the South African Air Force in 1945 as *4999* "Oubaas", was frequently at Northolt. *MW140* "Endeavour" performed a similar function for H.R.H. the Duke of Gloucester 1945–46 during his period of office as Governor-General of Australia. The R.A.A.F. serial group *A74*, reserved for Yorks, was never used and "Endeavour" retained its R.A.F. numbering.

Five other early Yorks were combination passenger/freighters 'borrowed' from R.A.F. production and allotted to B.O.A.C. as *G-AGJA–'JE*. They seated 12 passengers in the rear of the cabin (with the freight forward) and inaugurated the first U.K.–Cairo route via Morocco on April 22, 1944.

Production continued at Ringway until October 1945 when the jigs were transferred to the Yeadon factory. Here the last 77 examples were built, *PE108* the final York being completed in April 1948. Production for the R.A.F. (including the five for B.O.A.C.) amounted to 208 Yorks comprising five passenger transports, 114 pure freighters and 64 passenger/freighters. The first R.A.F. squadron wholly equipped with Yorks was No. 551 at



The first prototype Avro 685 York *LV626* as first flown with twin ruddered tail assembly.



LV626 after the addition of the central fixed fin and conversion to York C. Mk. 2 with four Bristol Hercules VI radials. (*Bristol Photo.*)

Lyneham in 1945 but by 1948 this and No. 24 had beeen joined by seven others wholly or partially York equipped for service on the world-wide trunk routes of R.A.F. Transport Command. During the Berlin Air Lift these squadrons carried 230,000 tons of supplies in 29,000 sorties.

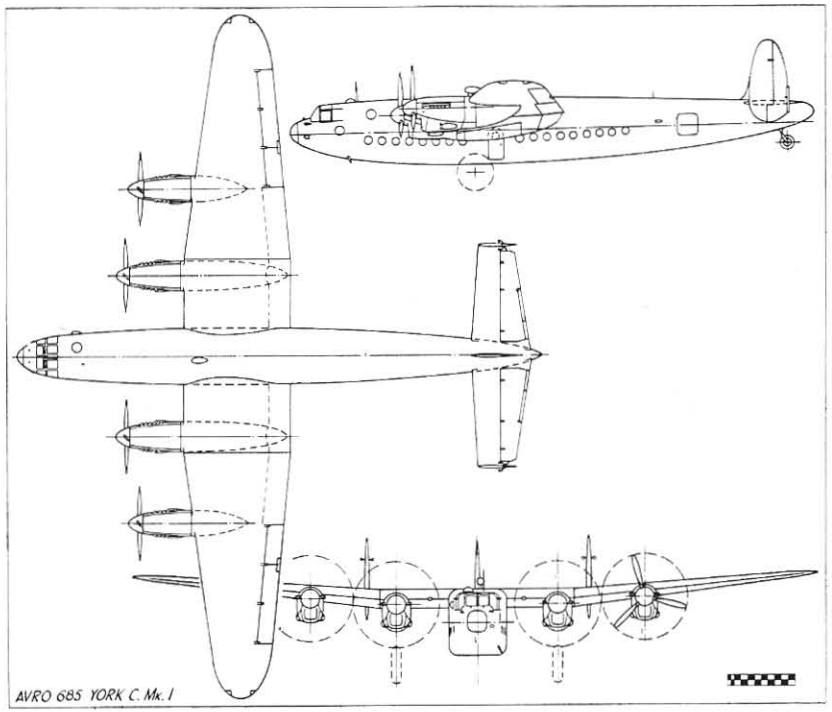
Included in a batch of 45 Yorks built after the war were a further 25 (*TS789–TS813*) for R.A.F./B.O.A.C. joint services; 12 for British South American Airways (*G-AHEW–'FH*); five 24 passenger machines for Flota Aerea Mercante Argentina (FAMA) for operation between Buenos Aires and London in competition with B.S.A.A.; and three 30 passenger machines for Skyways Ltd.; bringing total York production to 256. One additional York, *FM400*, built by Victory Aircraft Ltd. at Malton, Canada, for the R.C.A.F. in 1945, differed from British Yorks because the cabin floor did not slope when the aircraft was at rest. The line of windows was thus parallel to the ground instead of to the top of the fuselage.

In 1946 the joint services were handed over to B.O.A.C. and after overhaul at Croydon and Hamble, the Yorks were painted in B.O.A.C. livery as *G-AGNL–'OF* and *'SL–'SP*, with the M Class names given in the data section. Thirteen were fitted as 12 berth sleepers for the U.K.–Johannesburg 'Springbok' service, five being loaned to South African Airways 1946–47. Seven were also transferred temporarily to B.S.A.A. in 1948. Nine of the original B.S.A.A. Yorks were taken over when that company was absorbed by B.O.A.C. in 1949 but the entire fleet was withdrawn from passenger carrying on October 7, 1950. A few maintained the London–Singapore freight run in modern decor and flew replacement engines to stranded B.O.A.C. aircraft. Thirteen years' continuous service during which the York fleet flew 44 million miles and carried 90,000 passengers, ended on November 22, 1957 when the last two B.O.A.C. Yorks *G-AGJC* "Malmesbury" and *'SO* "Marston" were flown to Stansted for delivery to Skyways Ltd.

They joined a considerable number of secondhand and R.A.F. surplus Yorks including the Canadian *FM400* (acquired by Skyways Ltd. in June 1948 as *G-ALBX* "Sky Dominion") on long distance War Office trooping

contracts under the ownership of the Lancashire Aircraft Corporation Ltd., Eagle Aviation Ltd., Skyways Ltd., Surrey Flying Services Ltd., Air Charter Ltd., and Scottish Airlines (Prestwick) Ltd. As the Anglo-Egyptian Treaty of 1936 allowed only military aircraft to land in the Canal Zone, the Yorks were given temporary R.A.F. serials in the *WW-XJ* range. The longest trooping run was the regular London–Fiji service flown fortnightly by Air Charter Ltd. whose Yorks covered 24 million passenger-miles on this contract in 12 months.

At the time of the Berlin Air Lift, most surviving civil Yorks were owned by Skyways Ltd., whose original machine *G-AHFI* "Skyway" completed 147 sorties before crashing at Gatow; *'LV* "Sky Courier" no fewer than 467 sorties and *G-ALBX* a like number. Many R.A.F. Yorks exceeded these figures and when replaced in 1948 were ferried to Silloth, Aldergrove or Kirkbride for reduction to produce, but three were retained by the Transport Command Development Unit, Benson, until 1956 and about 30 others were disposed of to civil operators. Hunting-Clan Air Transport Ltd. and Dan-Air Services Ltd. became York operators for the first time, the former opening a U.K.–Africa York freight service on July 23, 1955. The noise level in the York left much to be desired and by 1963 only three certificated examples remained in the U.K.



The R.A.F.'s last operational York, *MW295* "Ascalon II", flew home from the Far East in March 1957 but was sold almost immediately to Trans-Mediterranean Airways as *OD-ACQ* and ferried to Beirut as *G-APCA*. It was one of many which worked out their useful lives on the pilgrim traffic to Mecca or on local airline services in Jordan, Saudi Arabia or Persia. Skyways Ltd. disposed of three Yorks to Persian Air Services in 1955 for freighting between Beirut and Teheran and the oil centres of Abadan and Kuwait, as well as to Basle, Switzerland, via Brindisi. Others were used by Air Liban and Middle East Air Lines, including *OD-ACN*, formerly General Smuts' "Oubaas" which M.E.A.L. obtained from Tropic Airways Ltd., who had flown it as a 54 seater on the Johannesburg–Amsterdam service as *ZS-DGN* since 1952.

Twelve Yorks completely overhauled by A. V. Roe and Co. Ltd. in 1955 were flown to Canada via Prestwick to airlift men and materials to the DEW Line sites along the Arctic Circle. During the operation they were flown by bush operators but on its completion were sold for airline work with Maritime Central Airways, Arctic Wings Ltd., Trans-Air Ltd., Associated Airways Ltd., and Pacific Western Airlines Ltd. Almost the last Yorks to leave R.A.F. service, *MW137* and *234* were acquired by the French Aéronavale and based at Le Bourget for general transport duties 1954–55.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester; Ringway Aerodrome, Manchester; Woodford Aerodrome, Cheshire; and Yeadon Aerodrome, Yorks.
Victory Aircraft Ltd., Malton, Ontario, Canada

Power Plants: (York C. Mk. 1) Four 1,620 h.p. Rolls-Royce Merlin T.24
Four 1,620 h.p. Rolls-Royce Merlin 502
(York C. Mk. 2) Four 1,650 h.p. Bristol Hercules VI

Dimensions: Span 102 ft. 0 in. Length 78 ft. 6 in.
Height 16 ft. 6 in. Wing area 1,205 sq. ft.

Weights: Tare weight 42,040 lb. All-up weight 68,000 lb.

Performance: (York C. Mk. 1) Maximum speed 298 m.p.h.
Cruising speed 233 m.p.h.
Initial climb 1,500 ft./min.
Ceiling 26,000ft. Range 2,700 miles

Production:

Four prototypes built at Manchester under Contract No. 2087/C4A: *LV626*, first flown at Ringway 5.7.42, converted to sole York C. Mk. 2, to No. 1 A.T.S. 1945 as *5554M*; *LV629* with passenger furnishings, to No. 4 S. of T.T. 1948 as *6554M*; *LV633* Churchill's "Ascalon", Far East Communication Flight 1946, broken up at North Coates Fittes 1954; *LV639* paratroop version, to No. 11 S. of T.T., Hereford 1947 as *6466M*

York C. Mk. 1 (**passenger version**) built at Manchester 1944 to Specification C.1/42 under Contract No. 2429/C4A: *MW100–102, 104, 106, 107, 109–112, 114–120, 122–128, 140.* Individual aircraft: *MW112* Rolls Royce Ltd., Hucknall, engine silencing tests; *MW140* Governor-General, Australia, Civil conversions (1953–57): *MW100/G-ANAA, MW104/G-ANAB, MW107* (S.A.A.F. *4999* "Oubaas")/*ZS-DGN/OD-ACN*; *MW110/G-AMUS* Air Charter "New Britain", *t/s *XF919*

* Trooping serial.

Civil Yorks for B.O.A.C.: *MW103, 108, 113, 121, 129* diverted 1944 as *G-AGJA–'JE*, c/n 1207–1211. *G-AGJA* "Mildenhall", later B.S.A.A.C. "Star Fortune" and B.O.A.C. "Kingston", t/s *WW541* and *WW508*; *'JB* "Marathon", t/s *WW503*; *'JC* "Malmesbury", t/s *WW504*; *'JD* "Mansfield"; *'JE* "Middlesex", later B.S.A.A.C. "Star Way" and B.O.A.C. "Panama", t/s *WW580*

York C. Mk. 1 (**freight version**) built at Manchester 1944–45 to Specification C.1/42 under Contract No. 2429/C4A; *MW105, 130–139, 141–149, 161–168, 170–172, 174–177, 179–185, 187–189, 191, 192, 194, 195, 200, 202, 203, 205, 207, 210, 223, 225, 228, 231, 232, 234, 235, 237–271, 284–290, 293, 294, 297, 299, 302, 305–309.* Civil conversions (1952–56): *MW135/CF-HMV*; *MW136/CF-HMW*; *MW138/G-AMRI* Surrey F/S "New Enterprise"/*OD-ACD*; *MW139/G-ANAW*; *MW141/G-ANXJ*; *MW143/G-ANTI*; *MW147/CF-HMZ*; *MW149/G-ANTJ*; *MW167/CF-HMX*; *MW177/G-ANTH*; *MW183/G-AMUU* Air Charter "Nouvelle Calédonie", t/s *XD668*; *MW185/G-AMUT/CF-HTM*; *MW203/CF-HMU*; *MW210/G-ANYA*; *MW231/G-ANGL/EP-ADA*; *MW232/G-ANTK*; *MW237/CF-HMY*; *MW253/G-ANVO*, t/s *XJ264*; *MW254/G-ANGF/OD-ADL*; *MW258/G-ANXN* Aviation Traders "New Charter"; *MW287/CF-HIP*; *MW290/CF-HAS*; *MW294/CF-HIQ*; *MW302/G-AMVZ*; *MW308/G-AMUL*, t/s *XF284*

York C. Mk. 1 (**passenger/freighter version**) built at Manchester and Yeadon 1945–48 to Specification C.1/42: *MW169, 173, 178, 186, 190, 193, 196–199, 201, 204, 206, 208, 209, 222, 226, 227, 229, 230, 233, 236, 272, 291, 292, 295, 296, 298, 300, 301, 303, 304, 310–333, PE101–PE108.* Civil conversions (1952–57): *MW178/G-ANXK*; *MW193/G-ANSY*, t/s *XG929*; *MW196/G-ANXL*; *MW199/G-AOAN*; *MW226/G-AMUV* Air Charter "New Venture II", t/s *XD669*; *MW227/G-ANXM*; *MW233/CF-HFP*; *MW236/G-ANAC*; *MW291/CF-HFQ*; *MW292/G-AMVY*; *MW295/G-APCA/OD-ACQ/EP-ADE*; *MW318/G-ANXO*; *MW321/G-AMUN*, t/s *XD667*; *MW323/G-AMXM/OD-ADM*; *MW326/G-AMRJ* Surrey F/S "New Era II", t/s *XG897/OD-ACE*; *MW327/G-ANRC*, t/s *XG898*; *MW332/G-AMUM*, t/s *XF285*

York C. Mk. 1 for joint R.A.F. Transport Command/B.O.A.C. use built at Yeadon 1945–46: *TS789–TS802/G-AGNL–'NZ*, c/n 1213–1227; *G-AGNL* "Mersey", t/s *WW581*; *'NM* "Murchison", t/s *WW511/XA192*; *'NN* "Madras", later South African Airways *ZS-BGU*, B.S.A.A.C. "Star Crest", B.O.A.C. "Atlantic Trader", t/s *WW465*; *'NO* "Manton", t/s *WW577* and *WW576*; *'NP* "Manchester", temporarily

ZS-BRA, t/s *WW509*, later *OD-ABT/OD-ACZ*; *'NR* temporarily *ZS-ATP* "Springbok", later B.O.A.C. "Moira"; *'NS* "Melville", temporarily *ZS-BTT*, later B.S.A.A.C. "Star Glory" and B.O.A.C. "Pacific Trader", t/s *WW466*; *'NT* "Mandalay", temporarily *ZS-ATU*, t/s *WW514*; *'NU* "Montgomery", temporarily *ZS-ATR* "Impala", later B.S.A.A.C. "Nassau", B.O.A.C. "Nassau", Air Charter "New Endeavour", t/s *XD670*, and *OD-ACO*; *'NV* "Morville" (later "Middlesex"); *'NW* "Morecambe", temporarily *ZS-ATS* "Sable", later B.O.A.C. "Caribbean Trader", t/s *WW581*, later *EP-ADB*; *'NX* "Moray", later B.S.A.A.C. and B.O.A.C. "Lima", t/s *WW582*; *'NY* "Melrose", t/s *WW510*; *'NZ* "Monmouth", temporarily *ZS-BRB*

TS803–TS808/G-AGOA–'OF, c/n 1228–1233: *G-AGOA* "Montrose", t/s *WW542*; *'OB* "Milford", t/s *WW501*; *'OC* "Malta", later B.S.A.A.C. "Star Path": *'OD* "Midlothian", t/s *WW576* and *WW577*, later *EP-ADC/OD-ACP*; *'OE* "Medway"; *'OF* "Macduff", temporarily *ZS-ATT*, t/s *WW579*

TS809–TS813/G-AGSL–'SP, c/n 1236–1240: *G-AGSL* "Morley", t/s *WW579*; *'SM* "Malvern", t/s *WW540*; *'SN* "Marlow", t/s *WW578*; *'SO* "Marston", t/s *WW467*; *'SP* "Marlborough", later "Santiago"

York C. Mk. 1 for British South American Airways Corporation built at Yeadon 1946. *G-AHEW–'FH*, c/n 1300–1311: *G-AHEW* "Star Leader"; *'EX* "Star Venture"; *'EY* "Star Quest", t/s *WW506* later *JY-ABZ*; *'EZ* "Star Speed"; *'FA* "Star Dale" t/s *WW504*; *'FB* "Star Stream", t/s *WW499* and *WW586*, temporarily *JY-AAC* in 1957; *'FC* "Star Dew", t/s *WW507*, later *OD-ACJ/HZ-CAA/EP-ADD*; *'FD* "Star Mist", t/s *WW500*, later *OD-ADB*; *'FE* "Star Vista", t/s *WW468* and *WW578*; *'FF* "Star Gleam", t/s *WW503*; *'FG* "Star Haze", t/s *WW468*; *'FH* "Star Glitter", t/s *WW502*, later *OD-ADA*

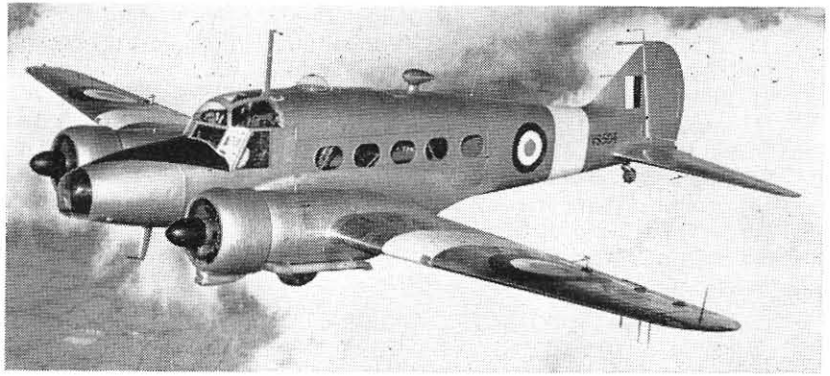
York C. Mk. 1 for Skyways Ltd. built at Yeadon 1946. *G-AHFI* "Skyway", c/n 1316; *G-AHLV* "Sky Courier", c/n 1340; *G-AIUP* "Sky Consul", c/n 1374

York C. Mk. 1 for Flota Aerea Mercante Argentina (**FAMA**) built at Yeadon 1946. *LV-XGN*, c/n 1354, re-registered *LV-AFV* after delivery, to Surrey F/S 1951 as *G-AMGL* "New Era", t/s *XA192*; *LV-XGO*, c/n 1355, operated as *LV-AFY*, to Surrey F/S 1952 as *G-AMGM* "New Venture"; *LV-XGP*, c/n 1356, operated as *LV-AFZ*, to Eagle Aviation Ltd. 1951 as *G-AMGK*, t/s *XA191* and *WW512*, temporarily *OD-ABV* in 1954; *LV-XIG*, c/n 1365 crashed 23.12.46; *LV-XIH*, c/n 1366, crashed 25.7.47

York C. Mk. 1 Special built for the Royal Canadian Air Force by Victory Aircraft Ltd., Toronto, Canada 1945. *FM400*, c/n PC4494, to Skyways Ltd. 1948 as *G-ALBX* "Sky Dominion", crashed at Wunsdorf, Germany 19.6.49

Service Use: (With Unit codes in parentheses)

R.A.F. Transport Command: Nos. 24, 40 (LE), 51 (TB), 59 (BY), 99, 206, 232, 242 (KY), 246 (VU), and 511 Squadrons. Training Units: No. 241 O.C.U. (YY), 1332 (T) C.U., 1384 (T) C.U. India H.Q. Communications Flight.



Avro 652A Anson T. Mk. 20 navigation trainer *VS504*. (*Avro Photo.*)

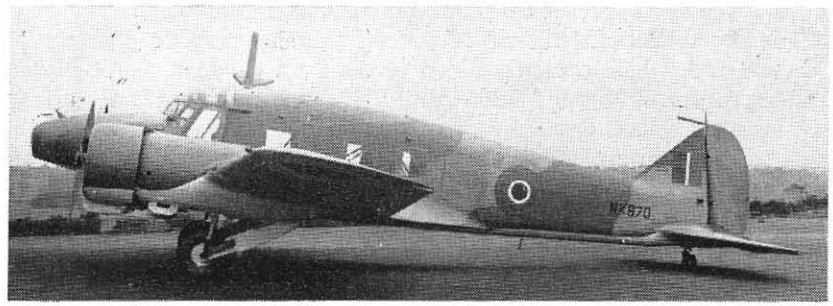
Avro 652A Anson Mks. 11 to 22

In 1944 the roof of the Anson cabin was raised to increase internal headroom, the 'greenhouse' glazing was replaced by three square windows on each side and flaps and undercarriage were hydraulically operated as on the Canadian Mk. II. The modernised Anson was built in two versions—Mk. 11 with two 395 h.p. Armstrong Siddeley Cheetah 19s driving fixed pitch Fairey-Reed metal airscrews, and Mk. 12 with two 420 h.p. Cheetah 15s turning Rotol constant speed airscrews. The two marks were only distinguishable externally because spinners were fitted to the v.p. airscrews of the Mk. 12.

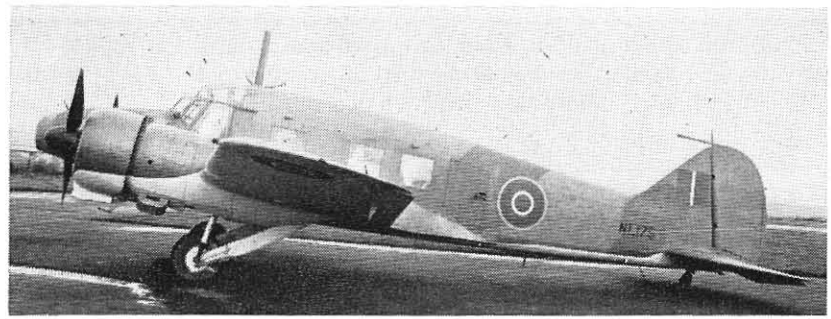
Anson 11 production, commencing *NK790* in May 1944, reached a total of 90 and continued parallel with the completion of 16 Anson Mk. Is as Anson Mk. 12s and the construction of a further 264 Anson Mk. 12s commencing *PH528*. Several were completed as ambulances with hinged wing root fillets on the port side to allow stretchers to be pushed into the cabin. *NK870*, the first Anson Mk. 11 ambulance, flew on July 30, 1944 and the first Anson Mk. 12 ambulance *NL153* on October 27 of that year. The prototype Anson Mk. 12 *NL152* (first flown at Woodford on September 5, 1944) and *NL246*, the last production Anson Mk. 11, became civil in the Autumn of 1944 as *G-AGLB* and *'LM* for temporary use by Air Attachés in Madrid and London respectively. *NL152* later reverted to the R.A.F. for communication duties until scrapped at Aldergrove in 1963, the only survivors of either mark then being Anson Mk. 11s *G-ALIH* equipped with large nose scanner for radar development work by E. K. Cole Ltd., Southend; and *G-ALXH* used for aerial mapping by B.K.S. Air Survey Ltd.

In 1945 A. V. Roe and Co. Ltd. fitted Anson Mk. 12 *MG159* with nine seats and five oval windows to satisfy the Brabazon XIX feeder liner specification of 1943. It thus became known as the Avro 652A Nineteen and was

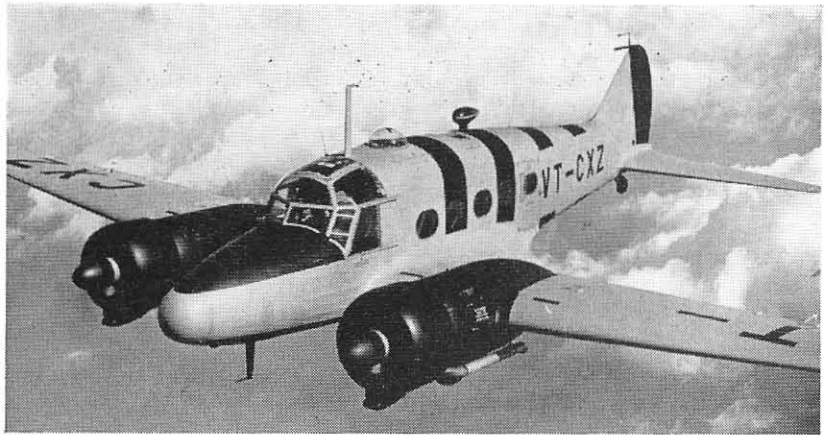
handed over to the Associated Airways Joint Committee as *G-AGNI* for evaluation on internal air routes. Anson Mk. 12 *G-AGLB* was then recalled from Madrid for similar conversion, but retained its square windows. A V.I.P. general transport version of this variant, ordered by the R.A.F. as the Avro C. Mk. 19 and built at Yeadon, appeared in two versions, Series 1 with wooden wings, and Series 2 with metal tailplane and tapering, fabric covered, metal mainplane of one foot greater span. The first 25, originally laid down as Anson Mk. 12s, were followed by a contract for a further 160, of which 67 (commencing *TX223*) were Series 2. Orders were placed later for 124 Series 2 aircraft but not all were delivered, 23 Series 1s being diverted to civil orders, one Series 2 to the Afghan Government and nine others to the R.A.F. as Anson T. Mk. 20 trainers. A few Series 2 machines, e.g. *VP514*, were equipped with vertical cameras for P.R. work, while others, e.g. *VL353*, had the perspex nose of the T. Mk. 20. Mark numbers 13 and 14 were reserved for turreted gunnery trainers and 15 and 16 for navigation and bombing training versions, but none of these was built. Designation Anson Mk. 18 was given to a batch of 12 general purpose aircraft equipped for police duties, liaison, transport and survey work by the Royal Afghan Air Force 1948–56. A second batch of 12, with opaque nose caps and D.F. loops repositioned



Anson Mk. 11 *NK870* with Armstrong Siddeley Cheetah 19s and fixed pitch airscrews.



Anson Mk. 12 *NL175* with Cheetah 15s and variable pitch airscrews.



Indian Government Anson Mk. 18C civil aircrew trainer *VT-CXZ*. (*Avro Photo.*)

farther aft, were delivered to the Indian Government as civil aircrew trainers under designation Anson Mk. 18C. Despite their earlier mark numbers, both these types were derived from the Mk. 19, the prototype Mk. 18 being a conversion of *VP511*, a production Anson C. Mk. 19 Series 2.

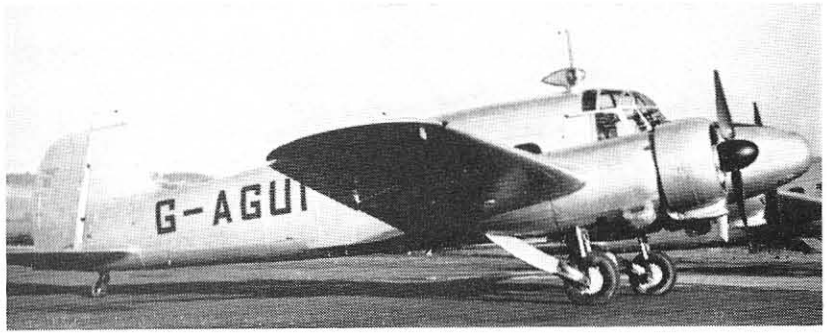
The largest fleet of civil Avro 19 Series 1 aircraft was that of Railway Air Services Ltd. which operated 14 on routes from Croydon to the North, Dublin, the Isle of Man and Belfast until 1947. The Ministry of Civil Aviation also maintained six at Gatwick for airport radio calibration and for instrument rating tests. Five were supplied to Egypt, one for Royal use and the others for airline service with Misrair; two to the Emperor of Ethiopia (*G-AGUH* and *'UI*); and others were sold to Hunting Air Travel Ltd., Sivewright Airways Ltd. and Westminster Airways Ltd. *G-AIKM*, originally the Rochester-based charter machine of Short Bros. and Harland Ltd., later became "Star Visitant", crew trainer of British South American Airways. Eventually these proud fleets dispersed to the four winds and by 1959 all the survivors had been absorbed by the aircraft industry as 'hacks', *G-AGUH* by Armstrong Siddeley Motors Ltd., *'WE* by the Decca Navigator Co. Ltd., *G-AHIC* by the College of Aeronautics, Cranfield, as an aerodynamic test vehicle (with experimental aerofoil sections flown vertically on the roof), *'XK* by Hawker Aircraft Ltd., and *'YN* by Armstrong Whitworth Aircraft Ltd.

The first production civil Avro 19 Series 1 *G-AGPG*, built at Yeadon in June 1946, remained in the service of A. V. Roe and Co. Ltd. for 16 years. They converted it to Series 2 in 1952 and sold it to Skyways Ltd., Lympne, ten years later. Production of the Avro 19 Series 2 for civil purposes was limited to 14 aircraft as shown in the data section.

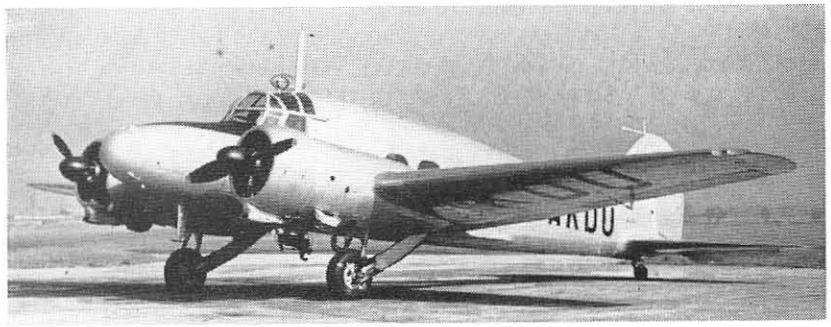
Many civil and Service Anson C. Mk. 12 and 19 machines were eventually modernised to Series 2 and fitted with the metal wing, as were several civil Mk. 11s. This was also common to the last three Anson variants, the T. Mk.

20, 21 and 22. Built to Air Ministry Specification T.24/46 as a general purpose trainer for Southern Rhodesia, the Anson T. Mk. 20 (prototype *VM305*) possessed several distinguishing features. For navigation training an astrodome was fitted on top of the fuselage, a moulded perspex nose was fitted for practice bomb-aiming, and bombs were carried in racks under the wings. The D.F. loop, situated just behind the pilot's cabin on the Avro 19, was moved back level with the fourth window. A small number of reserve Anson T. Mk. 20s which remained in the U.K. were flown without bomb racks.

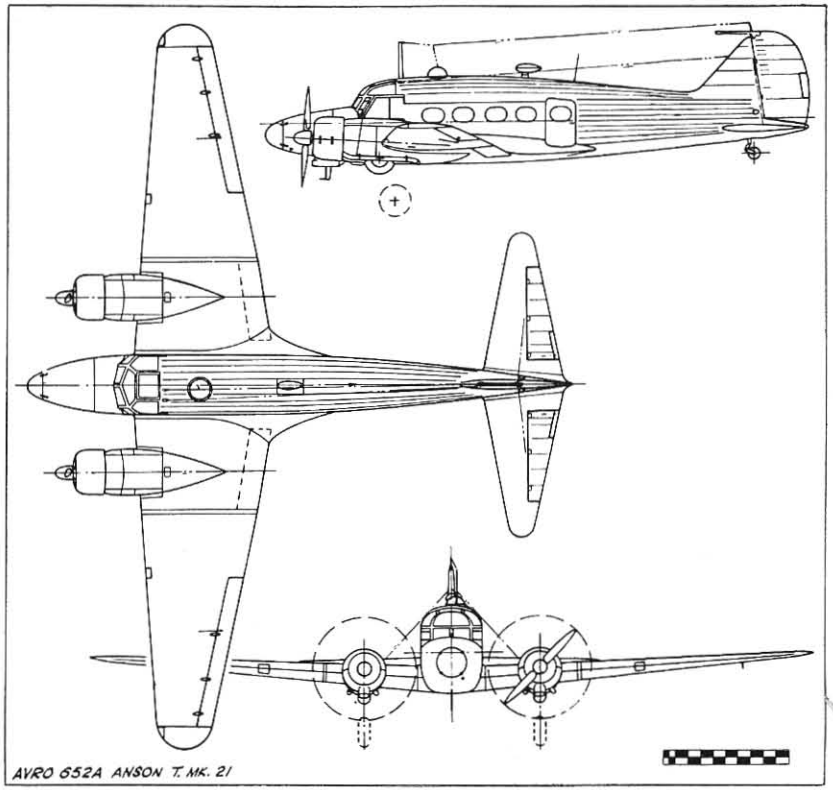
The Anson T. Mk. 21 to Air Ministry Specification T.25/46 (prototype *VS562*, first flown in May 1948), produced as a navigation trainer accomodating a crew of 6 for use in the British Isles by Flying Training Command, was identical externally to the T. Mk. 20 but had an opaque metal nose cap. Last came the T. Mk. 22, a radio trainer to Specification T.26/46 for the instruction of air signallers (prototype *VM306* flown in June 1948). It resembled the T. Mk. 21 but was without astrodome and could be identified further by the positioning of the D.F. loop above the second cabin window. In 1955 the prototype was used for airborne radar experiments with a bulbous nose of the type fitted to Ekco's *G-ALIH*. Anson T. Mks. 20, 21 and 22 differed from the Avro 19 and all earlier British marks because the engine



G-AGUI, an Avro 19 Series 1 aircraft supplied to the Ethiopian Government in 1945. (*Avro Photo.*)



Avro 19 Series 2 (tapered wing) *G-AKDU* at Heany, Southern Rhodesia, in 1947 with pest control spray gear under the fuselage.



nacelles carried no external oil coolers and had the exhaust pipes on the outboard instead of inboard sides. There were also fewer metal frames supporting the glazing of the pilots' cabin.

Seventeen years after going into production, the 11,020th and last Anson—the T. Mk. 21 *WJ561*—was test flown by Avro chief test pilot J. H. Orrell on May 15, 1952 and handed over to the R.A.F. by Sir Roy Dobson on the 27th. The career of an aircraft which had already eclipsed that of the immortal 504K was by no means over, however, and in 1954 the Fairey Aviation Co. Ltd. operated T. Mk. 20 *VS512* on survey work in Central Africa as *VP-YOF*. After 1958 it was used for the same purpose in the U.K. as *G-ANWW* at a time when obsolete R.A.F. Anson C. Mk. 19s were also being released for commercial use. Six flown to West Africa in 1958–59 were used on local services in Algeria, while others equipped overseas air forces, e.g. three to the Southern Rhodesian Air Force, but by December 1962 only about 100 remained in military service. A mere handful were left in civil employ, notably Avro 19 Series 2 *VH-RCC*, formerly *G-AHXK*, flown from Gatwick to Australia October 1–27, 1962 by Richard Cavill of Nicholas Air Charter Ltd., and wooden Anson I *VH-BAF* of Brain and Brown Airservices Pty., Moorabin, V., rebuilt with tapered metal wing from *VH-BIX*/*VM375*.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath and Chadderton, Manchester; and Yeadon Aerodrome, Yorks.

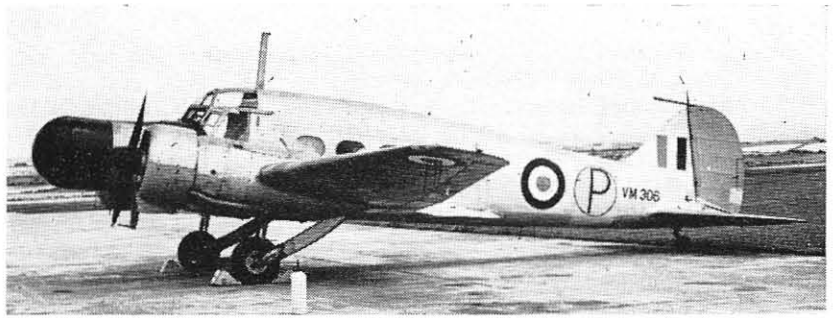
Power Plants:
(Anson Mk. 11) Two 395 h.p. Armstrong Siddeley Cheetah 19
(Anson Mk. 12) Two 420 h.p. Armstrong Siddeley Cheetah 15
(Anson Mk. 18) Two 420 h.p. Armstrong Siddeley Cheetah 17
(Anson Mks. 18C, 19, 20, 21 and 22) Two 420 h.p. Armstrong Siddeley Cheetah 15

Dimensions:
(Anson Mks. 11, 12 and 19 Series 1)
Span 56 ft. 6 in. Length 42 ft. 3 in.
Height 13 ft. 10 in. Wing area 463 sq. ft.
(Anson Mks. 18, 18C, 19 Series 2, 20, 21 and 22)
Span 57 ft. 6 in. Length 42 ft. 3 in.
Height 13 ft. 10 in. Wing area 440 sq. ft.

Weights and Performances:

	Mks. 11, 12, 19 Series 1	Mks. 18, 18C, 19 Series 2, 20, 21, 22
Tare weight	7,419 lb.	6,576 lb.
All-up weight	10,500 lb.*	10,400 lb.**
Maximum speed	190 m.p.h.	171 m.p.h.
Cruising speed	167 m.p.h.	149 m.p.h.
Initial climb	730 ft./min.	700 ft./min.
Ceiling	15,000 ft.	16,000 ft.
Range	610 miles	660 miles

*Anson Mk. 11 9,700 lb. **Anson T. Mk. 22 10,306 lb.



R.A.F. Avro C.19 Series 2 *VM306* with experimental radar scanner in the nose. (*Photo courtesy of 'Air Pictorial'.*)

Production:

Anson Mk. 11: Ninety aircraft laid down as Anson Mk. I but completed at Yeadon as Ansons Mk. 11s. *NK790, NK870–NK875, NK940, NK986–NK999, NL125, NL128, NL129, NL132, NL133, NL136, NL137, NL140, NL141, NL144, NL145, NL148, NL149, NL181–NL208, NL220–NL246.* Civil conversions: *NL132/G-ALIF; NL182/G-ALIG; NL186/G-ALIE; NL229/G-ALIH; NL231/G-AMBC; NL246/G-AGLM*

Anson Mk. 12: Sixteen aircraft laid down as Anson Mk. I but completed at Yeadon as Anson Mk. 12s. *MG159, NK150, NK151, NL152, NL153, NL171, NL172, NL175, NL176, NL179, NL180, NL247–NL251.* Civil conversions: *MG159/G-AGNI*, c/n 1214; *NL152/G-AGLB*, c/n 1205

Major production comprised 255 aircraft built at Yeadon under Contract No. 3077. *PH528–PH569, PH582–PH626, PH638–PH679, PH691–PH735, PH747–PH789, PH803–PH840.* Civil conversions: *PH599/ZK-AXY; PH806/SU-ADJ*, c/n 1272

Anson C. Mk. 19 Series 1: Seven aircraft converted at Yeadon from Anson Mk. 12s before delivery. *PH814–PH816, PH827, PH829, PH830, PH839.* Civil conversion: *PH830/G-AIRV*

Thirteen aircraft laid down at Yeadon as Anson Mk. 12 but completed as C. Mk. 19s. *PH841–PH845, PH858–PH865.* Civil conversions: *PH858/G-AIIA; PH860/G-AGWD*, c/n 1285 to Egyptian *VN889/SU-ADN* "Tanta"

Main production comprised 85 aircraft built at Yeadon under Contract No. 5037. *TX154–TX197, TX201–TX222, TX224–TX235, TX237–TX252, TX255.* Diverted to civil production before delivery: *TX201* and *TX202*, c/n 1286 and '87, to the Ministry of Civil Aviation as *G-AGWE* and *'WF*; *TX240–TX245*; *TX246/G-AHKC/SU-ADQ* c/n 1327, Misrair "Mona"; *TX247*; *TX248* and *TX249/G-AHKD* and *'KE*, c/n 1328–29, Misrair *SU-ADP* "Radwa" and *'DO* "Arafat"; *TX250–TX252, TX255*

Anson C. Mk. 19 Series 2: Production at Yeadon totalled 158 aircraft comprising 34 originally laid down as Series 1s—*TX223, TX253, TX254, TX256, TX257, VL285–VL313, VL333–VL363*; 95 aircraft to Contract No. 5680—*VM305–VM342, VM351–VM394, VM406–VM418*; 30 aircraft to Contract No. 6103—*VP509–VP538*; a further 100 aircraft to Contract No. 1396—*VV740–VV789* and *VV805–VV854* were cancelled. Diversions from Contract: *VL356, VM335* and *'37* to S.R.A.F. as *SR29–SR31*; *VL358–VL363, VM305, VM410–VM418* to Anson T. Mk. 20; *VP511* to prototype Anson Mk. 18 for the Afghan Government. Civil conversions: *VL298/G-AMNA; VL336/G-AJDH; VM336/G-ALFN*, c/n 1508; *VM360/G-APHV; VM373/G-AKUD*, c/n 1449; *VP512/G-AKFE*

Anson Mk. 18: Thirteen aircraft built at Yeadon for the Afghan Government comprising prototype *VP511* and 12 production aircraft *YA-A.251* to *YA-L.262*, c/n 1465–1476; *YA-A.*251, c/n 1509, supplied later to replace c/n 1465

Anson Mk. 18C: Twelve aircraft built at Yeadon for the Director General of Civil Aviation, India. *VT-CXT* to *VT-CYE*, c/n 1477–1488, British Cs. of A. issued 8, 18, 21, 29 and 31.3.49; 5 and 13.4.49; 3.5.49; 2, 5 and 10.8.49; 13.7.49 and 10.8.49 respectively

Avro 19 Series 1 civil and overseas production: c/n 1212, *G-AGPG*, C. of A. issued 6.8.45, Avro communications; 1214, *G-AGNI*, 23.1.45, Associated Airways Joint Committee; 1241, *G-AGPU*, 15.10.45, Air Attaché in Lisbon

c/n 1271, *G-AGPB*, C. of A. issued 3.1.46, Ministry of Civil Aviation; 1272, *SU-ADJ*, 26.9.45, see page 370; 1273–74, *G-AGUH* and *'UI*, 2.1.46, Imperial Ethiopian Air Force *IEAF.120–121*; 1275–78, *G-AGUD, 'UE, 'UX, 'VA*, 23.11.45, Railway Air Services Ltd.; 1285, *G-AGWD*, not taken up, see page 370; 1286-87, *G-AGWE* and *'WF*, 12.6.46, Ministry of Civil Aviation

c/n 1312, *OO-ANT*, C. of A. issued 3.5.46, John Mahieu Aviation, Brussels; 1317–25, *G-AHIB–'IJ*, 14.5.46–11.7.46, Railway Air Services Ltd.; 1327–29, *G-AHKC–'KE*, see page 370; 1330-31, *G-AGZS* and *'ZT*, 1.10.46 and 1332, *G-AGWA*, 24.6.46, Ministry of Civil Aviation

c/n 1351–53, *G-AHXK–'XM*, Hunting Air Travel Ltd. "Eland", "Oryx" and unnamed; 1357–58, *OO-APN* and *'PX*, 10.9.46, John Mahieu Aviation; 1359, *G-AHYN*, 13.8.46, Sivewright Airways Ltd. "Salfordia"; 1360, *G-AHYO*, 16.8.46, Westminster Airways Ltd.; 1363, *OO-APG*, 26.6.47, John Mahieu Aviation

Avro 19 Series 2 civil and overseas production: c/n 1313–1315 Irish Air Corps *141–143*; c/n 1333, *G-AHKX*, C. of A. issued 17.12.46, Smiths Aircraft Instruments Ltd.; 1361–62, *OO-CFA* and *'FB*, 13.12.46. Cie. Chemins de Fer du Congo Supérieur; 1364, *G-AIKM*, 31.10.46, Short Bros. and Harland Ltd.; 1369, *CF-FEQ*, 7.1.47, A. V. Roe Canada Ltd.; 1375, *G-AIYK*, 24.1.47, Hunting Air Travel Ltd.; 1376, *G-AIXE*, 17.3.47, Sivewright Airways Ltd.; 1377, *VT-CLI*, 22.5.47, Indian Air Survey and Transport Ltd.; 1383, *VT-CKA*, Bharat Airways, not taken up; 1384, *VT-CJZ*, 18.4.47, Bharat Airways Ltd.; 1423–24, *G-AKDU* and *'DV*, 25.9.47, Sec. of State for the Colonies, Southern Rhodesia; 1507, *LV-FBR*, test flown as *G-11-50*, for Argentina

Anson T. Mk. 20: Sixty aircraft built at Yeadon and comprising prototype *VM305* and 9 other aircraft *VM410–VM418* diverted from C. Mk. 19 series 2 production; 48 aircraft to Contract No. 811—*VS491–VS534, VS558–VS561*; and two aircraft to Contract No. 1396—*VV866, VV867.* Civil conversions: *VM305/G-APTL; VS512/G-ANWW*

Anson T. Mk. 21: 252 aircraft built at Yeadon and comprising 30 to Contract No. 1396—*VS562–VS591*; and 222 aircraft to Contract Nos. 1019, 2473, 3634 and 5343—*VV239–VV264, VV293–VV333, VV880–VV919, VV950–VV999, WB446–WB465, WD402–WD418, WD437–WD458*, WJ509–WJ519, WJ545–WJ561*

*Contract for 22 aircraft cancelled 13.7.50.

Anson T. Mk. 22: Fifty-four aircraft built at Yeadon comprising prototype *VM306* and 53 under Contract Nos. 1019 and 3634—*VS592–VS603, VV358–VV370, VV371–VV381*, VW100–VW114*, WD419–WD422 WD433–WD436*

*Contract for 26 aircraft cancelled.

Service Use: (unit codes used up to 1950 in parentheses)

Anson C. Mk. 11, 12, 19 and later 21, with a small number of C. Mk. 20 and 22, were used widely for communications and almost every R.A.F. Station Flight had at least one. The more important users were No. 31 Squadron (CB) (later the Metropolitan Communications Squadron); No. 58 (OT); No. 81 (photographic reconnaissance); and Nos. 173 and 527 Squadrons

Communications Flights: Bomber Command (4Z), Coastal Command, Fighter Command, Flying Training Command (FKN), Reserve Training Command (RCA), Technical Training Command (TWY), Central Flying School (FDI), Central Bomber Establishment (XE), Empire Flying School (FCV), Empire Air Armament School (FGC), Central Fighter Establishment, Transport Command, Maintenance Command, Northern Ireland (QU), Fighter Weapons School, R.A.F. Technical College, School of Land/Air Warfare, Radio Warfare Establishment (V7), No. 1689 Flight (9X), Middle East Communications Squadron, Aden Communications Flight, Far East Communication Squadron, Air Electronic School and the following Group Communications Flights—Nos. 1 (3V), 3 (3S), 11, 12 (WQ), 13, 18 (2V), 19 (G2), 21 (FKO), 22, 23 (FKP), 24, 27 (TSO), 38, 43 (1B), 61 (RCE), 62 (RCF), 63 (RCG), 64 (RCH), 66 (RCI), 84 (EP)

Anson T. Mk. 20: Used mainly by No. 3 Air Navigation School, Thornhill, Southern Rhodesia (coded Z) but a few remained in the U.K.

Anson T. Mk. 21: Nos. 1 (RCM), 3 (RCK), 5 (RCY), 7 (RCP), 8 (RCQ), 9 (RCZ), 10 (RSB), 11 (RCR), 12 (RCB), 14 (RCL), 15 (RCD), 16 (RCS), 17 (RCJ), 18 (RCT), 22 (RCU), 23 (RSA), 24 (RCV), 25 (RCW) and 48 Reserve Flying Schools; Nos. 1 (FFI, FFJ) and 2 (FFP) Air Navigation Schools; Nos. 1 and 2 (N) Basic Air Navigation Schools; No. 19 F.T.S. (FAG) (later the R.A.F. College); School of Flying Control (FDY)

Anson T. Mk. 22: Nos. 1 (TCR) and 4 (TMA, TSM) Radio Schools; No. 1 Air Signallers School; the Air Electronic School



The first production Avro 688 Tudor 1 *G-AGRC* with the early type of tail unit. (*B.O.A.C. Photo.*)

Avro 688 Tudor 1

In the autumn of 1943 it was clear that an interim type would be needed for the North Atlantic route until the big Brabazon Type I (Bristol 167), Type 3 (Avro 690 and 692—also referred to as the Avro XXII and XXIII), Type 3A (Avro 693) and Type 4 (D.H. 106) transports were ready. To meet this requirement A. V. Roe and Co. Ltd. conceived the idea of the Avro 687 (or Avro XX) with a circular section pressurised cabin but otherwise based on the Lancaster IV (or Lincoln) with four Merlin layout but using a single fin in place of the twin unit. To cover this suggestion the Air Ministry issued Specification 29/43 to the company in March 1944, calling for a 72,000 lb. transport to carry a 3,760 lb. payload for 4,000 miles, cruising at 235 m.p.h. at 25,000 ft.

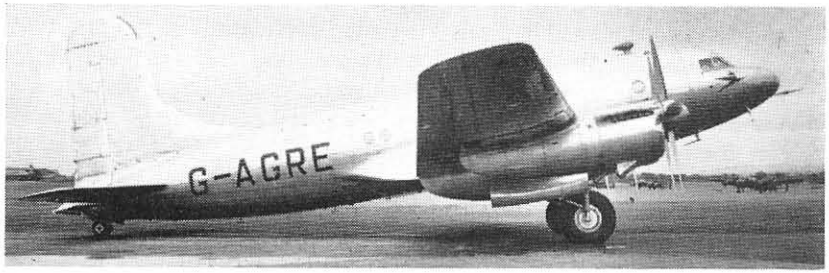
Heavy military commitments delayed detail design until the following June, but as work proceeded Lancaster conversion was abandoned and an entirely new 12 passenger type, the Avro 688 Tudor 1, emerged. Two prototypes were ordered in September 1944 and the first, *TT176/G-AGPF* powered by four 1,750 h.p. Rolls-Royce Merlin 102 engines, made its first flight at Woodford piloted by S. A. Thorn and J. H. Orrell on June 14, 1945. It was the first British pressurised transport but initial tests were made without pressurisation and with the tail wheel fixed. Trials continued at Woodford until April 1946 while work proceeded apace on 14 production aircraft (increased to 20 in April 1945) ordered for B.O.A.C. by the Ministry of Supply in November 1944. Flights trials with the prototype and the first and second production aircraft *G-AGRC* and *'RD* revealed directional and longitudinal instability (resulting in the fitment of larger fins, rudders and tailplanes), and pre-stall wing buffeting (cured by extending the wing root fillets and inner engine nacelles, and by sealing the wing leading edge/fuselage

junction). Airfield limitations at Woodford restricted prototype trials with *'PF* to an all-up weight of 65,000 lb., but when flown at Boscombe Down at the maximum take-off weight of 80,000 lb., a considerable landing bounce was apparent, corrected by fitting a shortened undercarriage. Boscombe Down also estimated the still air range at 3,600 instead of the expected 4,000 miles and attempts were made to improve matters by cleaning up the airframe and replacing the Merlin 600s (civil equivalent of the original Merlin 102s) by the more efficient Merlin 621s with reversible pitch capability.

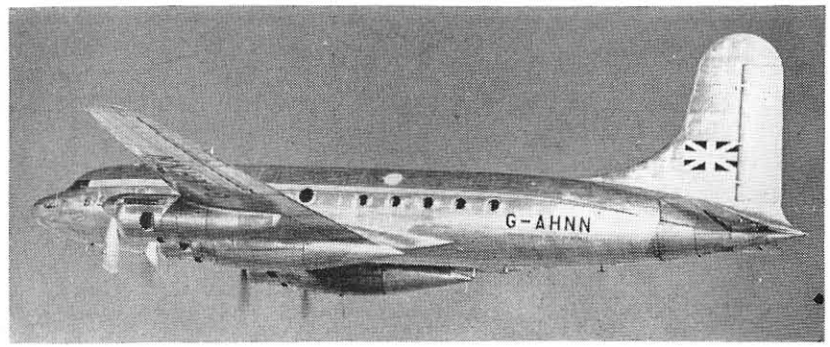
The unhappy Tudor 1 was not only the subject of protracted modifications but also victim of extremely high ideals set by B.O.A.C. for its first post-war airliner. At the final design conference on March 12–13, 1946 the Corporation called for no fewer than 343 changes in layout and decor, even though the whole production programme was already in serious disorder after two years of ever-changing decisions. Modifications recommended after unsatisfactory consumption tests and tropical trials at Nairobi in December 1946 with the second production Tudor 1 *G-AGRD* were incorporated in the seventh aircraft *'RI*, tested at Boscombe Down in February 1947. These included sealed engine cowlings, smooth de-icer pipes and increased engine compression ratio, while to improve airflow over the wing still further, the inner nacelles were extended beyond the trailing edge.

Despite the fact that a ceremony had taken place at London Airport on January 21, 1947 when the fourth production aircraft *G-AGRF* (Capt. S. W. A. Scott) was chosen as flagship of the future Tudor fleet and named "Elizabeth of England" by H.R.H. Princess Elizabeth, the Tudor was judged incapable of operating over the Atlantic and was finally rejected by the Corporation on April 11, 1947. At the same time the Australian Government abandoned its intention of building 12 Tudors in Australia to equip a transport squadron, even though a wooden mock-up had been constructed and serial group *A76* had been allotted.

A considerable number of production Tudors which had taken shape at Woodford included *G-AIYA* and *G-AJKC* which were despatched to Sir W. G. Armstrong Whitworth Aircraft Ltd. at Baginton, Coventry, to be



Tudor 1 *G-AGRE*, later the ill fated Tudor 4 "Star Ariel", showing the revised tail unit.



British South American Airways' Tudor 4 *G-AHNN* "Star Leopard".

fitted with luxury day and night accommodation for nine passengers as Tudor 3 transports for the personal use of Cabinet Ministers. They returned to Woodford with R.A.F. markings *VP301* and *VP312* respectively.

Four airframes were completed as Tudor 4s to the requirements of British South American Airways Corporation for whom the front fuselage was lengthened by 6 ft., the flight engineer's position deleted and the seat pitch decreased to enable 32 passengers, mail and freight to be carried. Conversions of early Tudor 1s *G-AGRD* and *'RE* which retained the flight engineer and carried 28 passengers were designated Tudor 4B. The 4s and 4Bs were supplied to B.S.A.A.C. to Specification 28/46B and the first example, *G-AHNJ* "Star Panther", was flown for the first time at Woodford by S. A. Thorn on April 9, 1947. The second aircraft *G-AHNK* "Star Lion", flown at Woodford on September 29 by J. H. Orrell, was immediately delivered to London by the same pilot so that its inaugural 16,500 mile demonstration and route proving flight to South America and back might begin next day. Piloted by Air Vice-Marshal D. C. T. Bennett via Lisbon, Dakar, Natal, Rio de Janeiro, Buenos Aires and Santiago, "Star Lion" returned on schedule and without incident on October 9. The fleet then settled down on the B.S.A.A.C. London–Bermuda route, but after the unexplained loss of *G-AHNP* "Star Tiger" north east of Bermuda on the night of January 29–30, 1948, and of *G-AGRE* "Star Ariel" between Bermuda and Jamaica on January 17, 1949, the remainder were stripped of furnishings and pressurisation and relegated to freight duties under designations Tudor Freighter 4 or 4B.

During the Berlin Air Lift the Corporation completed 261 sorties with *G-AGRG*, *'RH* and *'RJ* stripped as Tudor Freighter 1s, but when the operation ended in August 1949 the entire fleet was withdrawn from service and stored at Woodford. Later the aircraft were moved to Tarrant Rushton and Ringway but a number of new Tudors still in the Avro works were sold as scrap and broken up in R. J. Coley's yard at Dukinfield, Cheshire.



The second prototype Tudor 1 in its final form as the Tudor 8 *VX195* with four Rolls-Royce Nene 5 turbojets.

The second prototype *TT181/G-AGST* took part in the original modification programme and was subsequently rebuilt as a Tudor 4. Later still it was fitted with four 5,000 lb. s.t. Rolls-Royce Nene 4 turbojets in paired nacelles under the designation Tudor 8 and transferred to military marks as *VX195*, flying for the first time on September 6, 1948 and demonstrated at the Farnborough S.B.A.C. Show by J. H. Orrell a few days later. It was then handed over to Boscombe Down for test and eventually relegated to the 'outback' at Farnborough where it was broken up in 1951 and the fuselage donated to Teddington Controls Ltd. as a static test rig.

Prolonged negotiations by Aviation Traders Ltd. resulted in the purchase of all the surviving Tudors, comprising four Freighter 1s *G-AGRG-'RJ*; four Freighter 4Bs *G-AHNI*, *'NL*, *'NM* and *'NO*; and the two Freighter 3s *G-AIYA* and *G-AJKC*, as well as 88 new Merlin engines, on September 2, 1953. They were intended to replace Air Charter Ltd.'s long range Yorks, and *G-AGRI* and *'RG* were rushed into service and by following month *'RI* had already made a number of overseas flights from Northolt with temporary R.A.F. serial *XF739*. Between December 1953 and January 1954 all the other Tudors were flown to Southend for overhaul, followed a month later by the component parts of *G-AGRF*, *G-AHNK* and *'NN* by road from Hurn. Drastic modifications of *'RI* by upgrading the engines to Merlin 623, re-routing hydraulic and pneumatic lines, fitting Shackleton-type wheels and providing 42 rearward-facing seats, resulted in the issue of an unrestricted passenger carrying C. of A. in February 1954. Eventually all except *G-AGRJ* and *G-AJKC* were reconverted for passenger carrying but the War Office would not permit trooping by converted aircraft. In the following year therefore *'RG* "El Alamein" and *G-AIYA* were lengthened into Tudor 4s by Aviation Traders Ltd. at Stansted and modified to the same standard as *'RI*, which they joined on the Colonial coach service from Stansted to Idris and Lagos.

The utility of *G-AGRH* "Zephyr", *G-AHNI*, *'NM* and *'NO* was further improved by large 6 ft. 10 in. by 5 ft. 5 in. rectangular freight doors designed, constructed and tried out on the fuselage of *G-AHNK* by Aviation Traders Ltd. at Southend. With these doors in the port side and a permitted increase in all-up weight to 83,600 lb. the aircraft were renamed Avro Super Trader (or 4B) and granted a full C. of A. in March 1955. The prototype installation was made in *'NI* in April 1954 and later two of the improved Merlin 723 engines were tried experimentally in *'RH*.

The resuscitated Super Traders made many outstanding long distance charter flights, notably to Christmas Island in the Pacific, and fully justified their owners' faith in the soundness of the basic design. In August 1958 *G-AHNM* "Cirrus" flew as far as Christchurch, New Zealand, to collect Bristol Freighter spares. They remained in service until 1959 when *'RG* was burned out after swinging on take-off at Brindisi and *'RH* struck the 14,547 ft. summit of Mt. Suphan Dag in east Turkey while en route to Woomera, Australia.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire

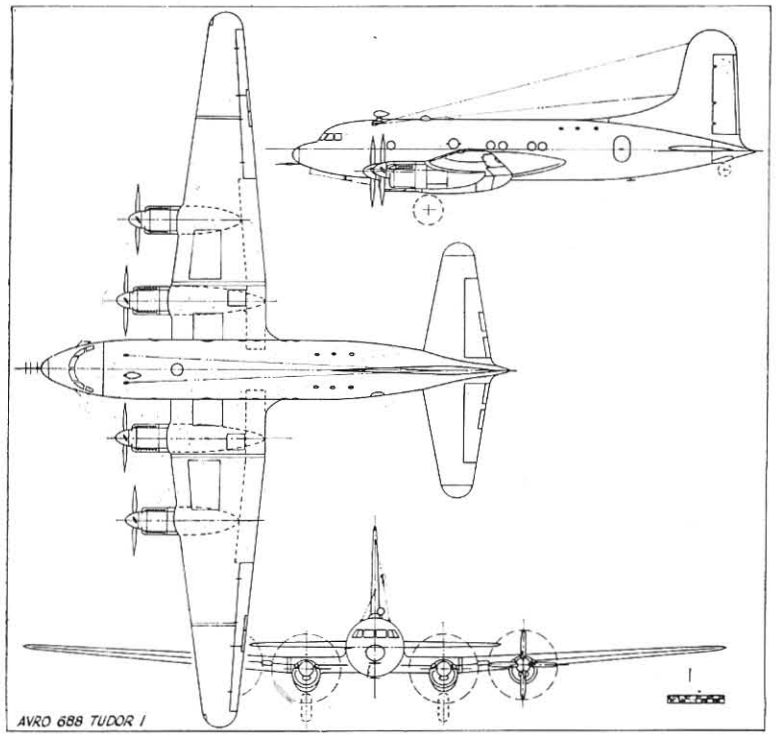
Power Plants:

(Tudor 1, first prototype)	Four 1,750 h.p. Rolls-Royce Merlin 102
(Tudor 1)	Four 1,750 h.p. Rolls-Royce Merlin 102A
	Four 1,740 h.p. Rolls-Royce Merlin 600
(Tudor 1, 3, 4, 4B)	Four 1,770 h.p. Rolls-Royce Merlin 621
	Four 1,760 h.p. Rolls-Royce Merlin 623
(Tudor 8)	Four 5,000 lb. s.t. Rolls-Royce Nene 5

Dimensions, Weights and Performances:

	Tudor 1	Tudor 3	Tudor 4	Tudor 4B	Tudor 8
Span	120 ft. 0 in.	120 ft. 0 in.	120 ft. 0 in.	120 ft. 0 in.	120 ft. 0 in.
Length	79 ft. 6 in.	79 ft. 3 in.	85 ft. 3 in.	85 ft. 3 in.	79 ft. 3 in.
Height	20 ft. 11 in.*	20 ft. 11 in.	20 ft. 11 in.	20 ft. 11 in.	20 ft. 11 in.
Wing area	1,421 sq. ft.	1,421 sq. ft.	1,421 sq. ft.	1,421 sq. ft.	1,421 sq. ft.
Tare weight	47,960 lb.	38,923 lb.	49,441 lb.	50,322 lb.**	34,724 lb.
All-up weight	71,000 lb.	78,761 lb.	80,000 lb.	82,000 lb.**	80,000 lb.
Maximum speed	260 m.p.h.	282 m.p.h.	282 m.p.h.	282 m.p.h.	385 m.p.h.
Cruising speed	210 m.p.h.	210 m.p.h.	210 m.p.h.	210 m.p.h.	350 m.p.h.
Initial climb	700 ft./min.	800 ft./min.	800 ft./min.	635 ft./min.	2,930 ft./min
Ceiling	26,000 ft.	27,400 ft.	27,400 ft.	23,500 ft.	44,000 ft.
Range	3,630 miles	4,000 miles	4,000 miles	3,500 miles**	1,720 miles

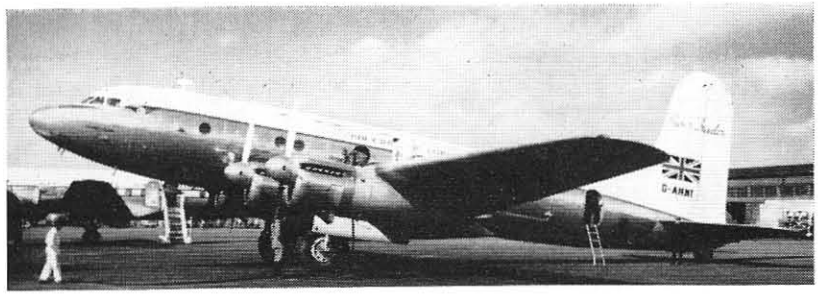
*Height 24 ft. 0 in. with original undercarriage.
**Super Trader 4 and 4B 45,375 lb., 83,600 lb. and 1,300 miles respectively.



Production:

(*a*) Tudor 1

Constructor's No. and Registration		*Details*
1234	*G-AGPF*	Initially *TT176*, C. of A. 18.11.47, to M.o.S. 1949 as *VX192*, scrapped at Woodford 12.50
1249	*G-AGST*	Initially *TT181*, rebuilt as Tudor 4 and later as Tudor 8 *VX195*, broken up at Farnborough 1951
1251	*G-AGRC*	First flown 12.1.46, scrapped at Woodford 12.48
1252	*G-AGRD*	Development aircraft, C. of A. 22.11.46, scrapped at Woodford 3.49
1253	*G-AGRE*	To Boscombe Down 8.46, C. of A. 25.9.46, to Woodford 11.46 for prototype Tudor 4B conversion
1254	*G-AGRF*	C. of A. 6.12.46, B.O.A.C. "Elizabeth of England", converted to Tudor 4B in 1948
1255	*G-AGRG**	C. of A. 10.1.47, B.S.A.A. Tudor Freighter 1 "Star Cressida", converted to Super Trader 4 in 1956
1256	*G-AGRH**	C. of A. 10.12.46, B.S.A.A. Tudor Freighter 1, converted to Super Trader 4B in 1956
1257	*G-AGRI**	C. of A. 3.2.48, Air Charter Ltd. trooping 10.53 as *XF739*, dismantled at Southend 10.54
1258	*G-AGRJ**	C. of A. 24.2.47, dismantled at Stansted 8.56
1259	*G-AGRK*	Transferred to the M.o.S. as *TS874* and *TS875* respectively and eventually scrapped at Woodford
1260	*G-AGRL*	



Super Trader 4B "Trade Wind" *G-AHNI* of Air Charter Ltd. The hinges of the freight door are visible forward of the ladder.

(*b*) Tudor 3

Constructor's No. and Registration		*Details*
1367	*G-AIYA**	Temporarily *VP301* in 1948, C. of A. 14.2.50, converted 5.54 to Tudor 1
1368	*G-AJKC**	Temporarily *VP312* in 1948, C. of A. 14.2.50, scrapped at Southend 8.56

(*c*) Tudor 4 and 4B

Constructor's No. and Registration		*Details*
1253	*G-AGRE*	B.S.A.A. "Star Ariel", C. of A. 12.11.48, lost in the Western Atlantic 17.1.49
1254	*G-AGRF**	C. of A. 8.12.48, dismantled at Hurn 1953, components by road to Southend
1255	*G-AGRG**	C. of A. 31.1.54, converted to Super Trader 4 "El Alamein" for Air Charter Ltd. 7.56, burned out at Brindisi 27.1.59
1256	*G-AGRH**	C. of A. 25.10.55, converted 7.56 to Super Trader 4B "Zephyr", crashed on Mt. Suphan Dag, Turkey 23.4.59
1341	*G-AHNH*	Construction abandoned
1342	*G-AHNI**	B.S.A.A. "Star Olivia", C. of A. 24.2.50, converted to Super Trader 4B "Trade Wind" for Air Charter Ltd. in 1956, scrapped at Stansted 6.59
1343	*G-AHNJ*	B.S.A.A. "Star Panther", C. of A. 18.7.47, reduced to spares at Ringway 1953
1344	*G-AHNK**	B.S.A.A. "Star Lion", C. of A. 30.9.47, reduced to spares at Ringway 1953
1345	*G-AHNL**	C. of A. 14.2.50, converted to Super Trader 4B in 1956, scrapped at Southend 2.60
1346	*G-AHNM**	C. of A. 6.3.50, converted to Super Trader 4B "Cirrus" for Air Charter Ltd. in 1956, scrapped at Stansted 6.59
1347	*G-AHNN**	B.S.A.A. "Star Leopard", C. of A. 23.3.48, to spares at Ringway 1953
1348	*G-AHNO*	C. of A. 24.2.50, converted to Super Trader 4B "Conqueror" for Air Charter Ltd. 1956, scrapped at Stansted 8.59
1349	*G-AHNP*	B.S.A.A. "Star Tiger", C. of A. 5.11.47, lost in the Western Atlantic 30.1.48
1350	*G-AHNR*	Construction abandoned

*Acquired by Aviation Traders Ltd. 2.9.53.

Note: All Tudor 1 and 4 aircraft were allotted B.S.A.A. Star class names but only those actually used are recorded above. Cs. of A. were not issued to *G-AGST*, *'RC*, *'RK*, *'RL*, *G-AHNH* and *'NR*



Avro 689 Tudor 2 prototype *G-AGSU* with original tail unit, taking off from Woodford for an early test flight on April 3, 1946. (*B.O.A.C. Photo.*)

Avro 689 Tudor 2

The Tudor 2 (or Avro XXI) was designed originally as a stretched version of the Tudor 1 to carry 60 passengers for B.O.A.C. as the Avro 689 and for B.E.A.C. as the Avro 699. To this end the fuselage diameter was to be increased by 1 ft. and the length by 25 ft., with the flying surfaces, power plants and undercarriage remaining unchanged. In November 1944, while the aircraft was still in the design stage, B.O.A.C., QANTAS and South African Airways decided to standardise it on all the Commonwealth routes and the original B.O.A.C. order for 30 was increased to 79. By May 1945, however, aerodynamic considerations and the operators' changing requirements had increased the length to no less than 105 ft. 7 in., making the Tudor 2 the largest aircraft produced in the U.K. up to that time.

Four months of flight testing followed the maiden flight of the Tudor 2 prototype *G-AGSU* at Woodford by S. A. Thorn and J. H. Orrell on March 10, 1946. It then went to Boscombe Down for certification trials and the original Rolls-Royce Merlin 102s were changed for the civil equivalent designated Merlin 600 Special. Teething troubles similar to those of the Tudor 1 were soon encountered and '*SU* returned to Woodford in September 1946 for rearward extension of the inner nacelles and the fitting of the enlarged type of fin and rudder. Increases in structural weight resulting from the stretching processes and subsequent modifications had by this time reduced performance to the point where the Tudor 2 could no longer operate from aerodromes east of Calcutta or south of Nairobi. QANTAS and South African Airways were thus compelled to re-equip with American types and the Tudor 2 order was reduced to 50, at which stage tragedy overtook the prototype which crashed on take-off from Woodford on August 23, 1947 due to incorrect assembly of the aileron circuit, an accident which cost the lives of Avro's famous chief designer Roy Chadwick and test pilot S. A. 'Bill' Thorn.

In an attempt to recover some of the lost performance, the first production Tudor 2 *G-AGRX* was completed with four 1,750 h.p. Bristol Hercules 120 radial engines, redesignated Tudor 7 and first flown on April 17, 1946 in

time for that year's Radlett S.B.A.C. Show. When the shortened undercarriage was fitted in June 1948 the engine nacelles were tilted to give greater airscrew clearance and the aircraft used for cabin heating tests before delivery to the Ministry of Supply in March 1949 as *VX199* for use at the Telecommunications Research Establishment, Defford.

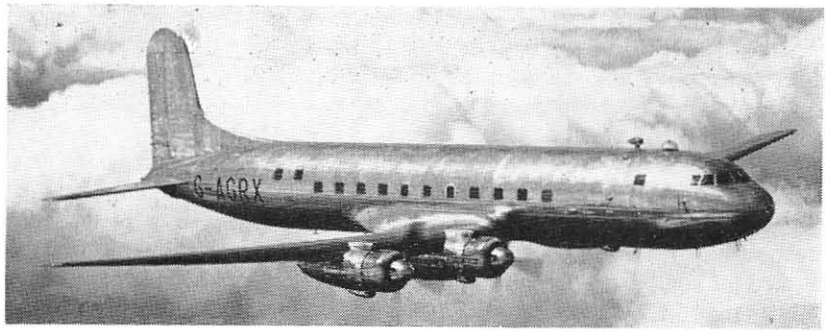
Merlin-powered Tudor 2 development continued with the second production aircraft *G-AGRY* which the M.o.S. sent to Nairobi for tropical trials as *VX202*. These proved unsatisfactory and orders were cut back drastically to 18, made up of two Tudor 2s for experimental work, ten earmarked for completion with tricycle undercarriages as Avro 711A Traders to Specification 23/48, and six to B.S.A.A. requirements as Tudor 5s to Specification 39/46. The experimental machines *G-AGRZ* and '*SA* were loaned to the R.A.E., Farnborough, and Rolls-Royce Ltd., Hucknall, respectively and used military marks for pressurisation, airscrew and engine development but the Trader programme was shelved. One other Tudor 2, *FM300*, produced in Canada, is discussed in the Avro 694 Lincoln chapter.

Powered by four 1,770 h.p. Rolls-Royce Merlin 621s, the Tudor 5s were identified by circular instead of square windows and were equipped to carry 44 passengers by day or 36 by night (28 seated, 8 sleeping). Painted in full B.S.A.A. livery, they were delivered to the company's engineering base at Langley but did not go into scheduled service. Instead, they were stripped of furnishings and used as tankers on the Berlin Air Lift, the first, *G-AKBY*, being sold to Airflight Ltd. of Blackbushe, which had already acquired Tudor 2 *G-AGRY*. After 85 trips from Wunsdorf to Gatow, each time carrying $9\frac{3}{4}$ tons of mixed freight, the latter also became a tanker and in just over a year the immense total of 3,167 tanker sorties was flown by the seven 'large' Tudors, *G-AKBY* being landed on one occasion successfully by Air Vice-Marshal Bennett on the trimmers alone after taking off with the elevator locked.

On their return to England the aircraft were refurnished for passenger work but '*BY* crashed with a loss of 80 lives due to incorrect loading on March 12, 1950 when approaching to land at Llandow at the end of a charter flight from Dublin. *G-AKCA* flew to Montreal in 1952 and appeared for a



British South American Airways Tudor 5 *G-AKCB* "Star Kestrel". (*E. J. Riding Photo.*)



The Tudor 7 *G-AGRX* with revised tail unit.

short time in the colours of Lome Airways as *CF-FCY* before returning to Stansted; while *'CC* and *'CD* were disposed of to William Dempster Ltd. and converted to 52 seat layout for London–Johannesburg tourist flights. After *'CC* was damaged beyond repair when landing at Bovingdon from Castel Benito on October 26, 1951 its sister machine went to Stansted, where it was gradually broken up with other Tudor 5s to provide spares for Air Charter Ltd's Super Traders and for Tudor 2 *G-AGRY* which made 13 trooping flights to the Canal Zone for this company as *XF537* in September 1953.

Designation Tudor 6 was reserved for six aircraft ordered by the Argentine Air Line FAMA for operation over the South Atlantic with 32–38 day or 22 night passengers. Although airframe numbers were allotted and application made for Cs. of A., they were not completed. Also derived from the Tudor 2 were six aircraft powered by four Rolls-Royce Nene turbojets and equipped with tricycle undercarriages. First referred to as the Avro 689 Tudor 9, this variant was eventually built as the Avro 706 Ashton high altitude research type described later in this book.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; Ringway Aerodrome, Manchester; and Woodford Aerodrome, Cheshire

Power Plants:
(Tudor 2) Four 1,750 h.p. Rolls-Royce Merlin 102
Four 1,740 h.p. Rolls-Royce Merlin 600A
Four 1,770 h.p. Rolls-Royce Merlin 621
(Tudor 5) Four 1,770 h.p. Rolls-Royce Merlin 621
(Tudor 7) Four 1,750 h.p. Bristol Hercules 120

Dimensions:
Span 120 ft. 0 in. Length 105 ft. 7 in.
Height 24 ft. 3 in. Wing area 1,421 sq. ft.

Weights:
(Tudor 2 and 5)
Tare weight 46,300 lb. All-up weight 80,000 lb.
(Tudor 7) Tare weight 51,625 lb. All-up weight 80,000 lb.

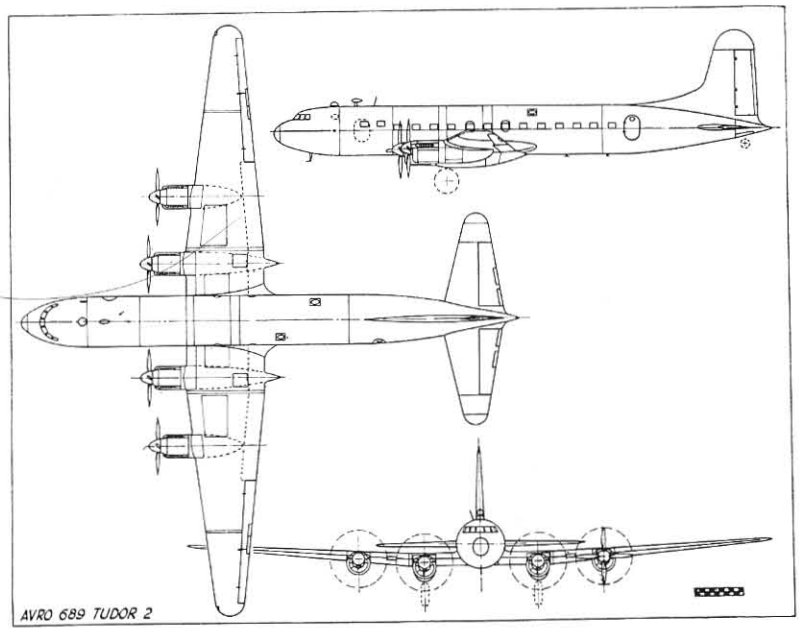
Performance:
(Tudor 2 and 5)
Maximum speed 295 m.p.h.
Cruising speed 235 m.p.h.
Initial climb 740 ft./min. Ceiling 25,550 ft.
Range 2,330 miles
(Tudor 7) Maximum speed 270 m.p.h.
Cruising speed 200 m.p.h.
Initial climb 750 ft./min. Ceiling 25,100 ft.
Range 2,800 miles

Production:

(*a*) **Tudor 2**

Constructor's No. and Registration		*Details*
1235	*G-AGSU*	Prototype, destroyed at Woodford 23.8.47
1250	*G-AGSV*	Intended as prototype Avro 711A Trader, construction abandoned
1262	*G-AGRY*	Initially *VX202*, C. of A. 1.9.48, to Airflight Ltd. 9.48, to Fairflight Ltd. 4.50, to Air Charter Ltd. 1953, temporarily *XF537*, scrapped at Stansted 7.59
1263	*G-AGRZ*	To M.o.S. 1.51 as *VZ366*, to Flight Refuelling Ltd. 11.53 as *G-AGRZ*, to Aviation Traders Ltd. for spares 3.54, scrapped 7.59
1264	*G-AGSA*	To M.o.S. 1.49 as *VZ720* on loan to Rolls-Royce Ltd., Hucknall, scrapped at Farnborough 10.53

Note: The following reservations for Tudor 2s were not taken up: *G-AJJV* to *'KB*, c/n 1395–1401; *G-AKTH* to *'TT*, c/n 1425–1439; *G-AKUE–'UP*, c/n 1440–1448



(*b*) Tudor 5

Constructor's No. and Registration		*Details*
1417	*G-AKBY*	Airflight Ltd., C. of A. 24.9.48, crashed at Llandow 12.3.50
1418	*G-AKBZ*	B.S.A.A. "Star Falcon", C. of A. 3.11.48, scrapped at Stansted 7.59
1419	*G-AKCA*	B.S.A.A. "Star Hawk", C. of A. 7.12.48, temporarily to Lome Airways as *CF-FCY* in 1952, scrapped at Stansted
1420	*G-AKCB*	B.S.A.A. "Star Kestrel", C. of A. 31.12.48 scrapped at Stansted 7.59
1421	*G-AKCC*	B.S.A.A. "Star Swift", C. of A. 26.1.49, William Dempster Ltd. "President Kreuger", damaged at Bovingdon 26.10.51
1422	*G-AKCD*	B.S.A.A. "Star Eagle", C. of A. 11.2.49, scrapped at Stansted 1956

(*c*) Tudor 6

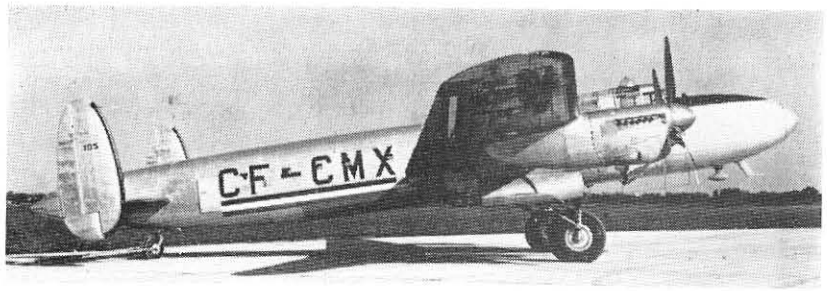
Six aircraft, c/n 1386–1391, ordered by Flota Aerea Mercante Argentina (FAMA), were not built

(*d*) Tudor 7

Constructor's No. and Registration		*Details*
1261	*G-AGRX*	First flown 17.4.46, to M.o.S. 3.49 as *VX199*, to Flight Refuelling Ltd. 11.53 as *G-AGRX*, to Aviation Traders Ltd. as spares 3.54, scrapped at Stansted 9.59

(*e*) Avro 711A Trader

Prototype *G-AGSV*, c/n 1250, and nine production aircraft comprising *G-AGSB* to *'SG*, c/n 1265–1270 (registered 9.45 to the Ministry of Supply and Aircraft Production) and *G-AJJS* to *'JU*, c/n 1392–1394 (registered to the Ministry of Supply 3.47). None of these was completed



Trans-Canada Air Lines' Lancastrian *CF-CMX*. (*Rolls-Royce Photo.*

Avro 691 Lancastrian

To prepare for a Canadian transatlantic service, M. B. Barclay and G. B. Lothian, senior Trans Canada Air Lines captains, were seconded to the R.A.F./B.O.A.C. North Atlantic ferry in 1941 and a British-built Lancaster III *R5727* acquired. This was flown to Malton in August 1942 where Victory Aircraft Ltd. faired over the nose and tail turrets and removed the mid-upper. Stripped of camouflage and provided with three extra windows at the rear, it was handed over to T.C.A. for evaluation and given Fleet No. 100. Known affectionately as "Old T.C.A.100", it made experimental freight runs from Moncton to Goose Bay piloted by Capt. Barclay and quickly proved its ability to carry loads of up to 14,000 lb. over great distances at reasonable speed.

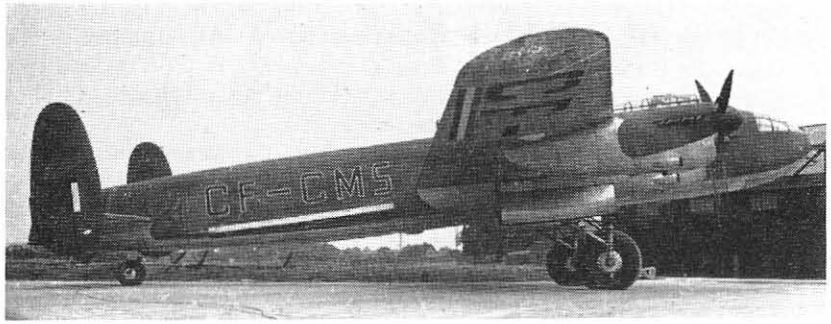
It was then flown back to England where A. V. Roe and Co. Ltd. completed its demilitarisation and replaced the turrets by streamlined wooden fairings designed and supplied by Victory Aircraft Ltd. Unlike the nose cones of later conversions, that of T.C.A.100 was quite short and housed the navigator under a glazed roof. Extra fuel tanks increased the still air range to 4,000 miles and seats for ten passengers were installed. Re-camouflaged, registered *CF-CMS* and piloted by Capt. R. F. George, it inaugurated the T.C.A.-operated Canadian Government Trans Atlantic Air Service on July 22, 1943 by flying 4 tons of Forces' mail nonstop Dorval–Prestwick in the record time of 12 hrs. 26 min. The machine was then cleared for passenger carrying, was granted a British C. of A. on September 1, 1943 and on March 3, 1944 set up a westbound record to Montreal of 12 hr. 59 min. carrying 3,611 lb. of mail, 435 lb. of freight and four passengers.

These successes prompted T.C.A. to convert two Canadian-built Lancaster Xs at Montreal. Redesignated Lancaster XPPs they were joined later in 1944 by five more Lancaster Xs converted by Victory Aircraft Ltd. at Malton, who produced a more elegant version with longer, all-metal, semi-monocoque nose which increased the mail capacity to $3\frac{1}{2}$ tons. One T.C.A. conversion was lost over the Atlantic with British Admiralty officials in December 1944, and *CF-CMS* was burned out in a take-off accident at Dorval in June 1945 during trials with four Merlin 85 engines in Lincoln-type annular cowlings.

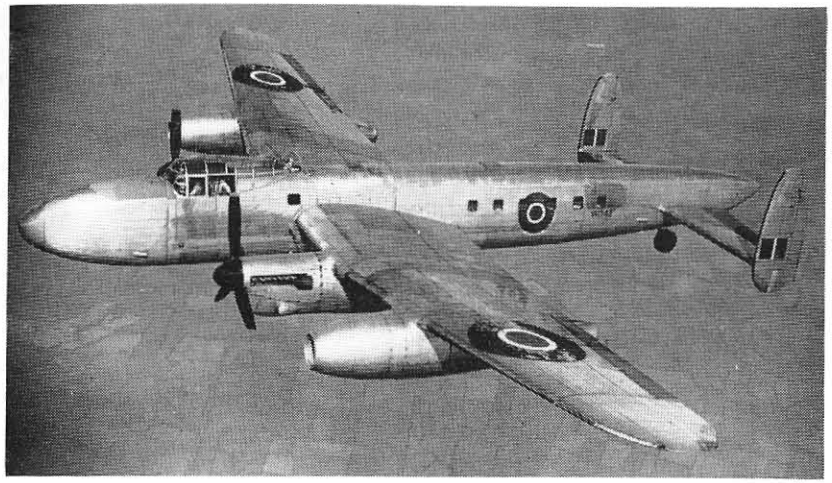
The remaining six plied twice weekly between Dorval and Prestwick until September 16, 1946 when the route was extended to London and became a public scheduled service, but the aircraft were quite uneconomic in civil use and were replaced in 1947, having completed 1,900 ocean crossings.

An outstanding long distance flight was made by *CF-CMW* (Capt. G. B. Lothian) which left Prestwick on July 9, 1946 with a crew of four and ten passengers and flew to Vancouver in an elapsed time of 28 hrs. 23 min. with a single refuelling stop at Dorval.

A more sophisticated conversion with 500 gallon fuel tanks in the bomb bay but outwardly similar to the Victory machine, was put into production by A. V. Roe and Co. Ltd. in 1944 under the designation Avro 691 Lancastrian 1. It was intended as an interim type for B.O.A.C.'s Australian routes until the Tudors were ready, and the first aircraft *VB873/G-AGLF* was handed over to the Corporation's Development Flight at Hurn early in 1945. Two months later Capt. R. G. Buck's record breaking 3½ day flight to New Zealand in this machine heralded a new era of fast Commonwealth schedules. Although 32 aircraft from the tail end of Lancaster production were earmarked for B.O.A.C., only 20 were completed, the last delivery being in October 1945. Registered *G-AGLS* to *'MM* (less *'MI*), they operated jointly with QANTAS on the Kangaroo service in R.A.F. Transport Command coding, Australian crews taking over at Karachi. The inaugural eastbound service was flown by *G-AGLV/OKZV* (Capt. E. Palmer) ex Hurn on May 31, 1945 while the westbound machine *G-AGLS/OKZS* left Sydney on June 2. After the loss at sea north of the Cocos Islands on March 24, 1946 of *G-AGLX* (Capt. Thomas) in which Jack Dobson, son of A. V. Roe's managing director, was flying to Australia to organise Lincoln production, the Lancastrians settled down to a career of high utilisation. With accommodation for only nine passengers and carrying a limited quantity of mail, the type was anything but economic in operation, nevertheless an estimated annual loss of £1·4m. on the Kangaroo route was accepted as the price of maintaining a fast British prestige service to Sydney.



"Old T.C.A. 100" *CF-CMS*, the original demilitarised Lancaster from which the full Lancastrian modification was developed.



VH742 flying on the power of two Rolls-Royce Nene 1 turbojets, 1946. (*'Flight' Photo 20644S.*)

The Lancastrian was also the first British commercial aeroplane with South Atlantic capability, and on October 5, 1945 Capt. O. P. Jones left Hurn in *G-AGMG* to survey the route which had long been a British ambition. The ease with which the Lancastrian crossed the ocean to Buenos Aires, and continued over the Andes to Santiago and Lima, resulted in the delivery of six Lancastrian 3s *G-AGWG* to *'WL* for the establishment of a regular B.S.A.A.C. service in the following year. The Mk. 3 was equipped with additional windows and improved internally to accommodate 13 passengers.

R.A.F. commitments to India, the Far East and Australia were met by equipping Transport Command with nine seat Lancastrian C. Mk. 2s to Specification C.16/44. They were similar to the civil Lancastrian 1 but the total R.A.F. order (deliveries commenced October 16, 1945) included twenty 10–13 seat Lancastrian C. Mk. 4s, equivalent to the civil Lancastrian 3. Production ceased at the 82nd aircraft at the end of 1946 and the last to leave Woodford were 12 civil examples of which five, collected by B.E.A.C. and flown to White Waltham for ferrying to Alitalia, were named after Mediterranean winds for a weekly Rome–Montevideo South Atlantic service which began on June 2, 1948. The remaining seven, comprising three which formed the initial equipment of Silver City Airways Ltd., and four sold to Skyways Ltd., were used for long distance charters to South Africa, Australia and the Far East. Skyways Ltd. also commissioned eight ex R.A.F. Lancastrian C. Mk. 2s and 4s 1947–48, of which five were sold to B.S.A.A.C. and B.O.A.C. to alleviate fleet shortages caused by the failure of the Tudor. Three additional Lancastrian C. Mk. 4s were overhauled by A. V. Roe and Co. Ltd. for Flota Aerea Mercante Argentina (FAMA) but in 1949 these were taken over by the

Argentine Air Force and served as V.I.P. transports with the V Brigada Aeria at Villa Mercedes.

Four of B.O.A.C.'s early Lancastrian 1s, sold to QANTAS in November 1947, continued on the Kangaroo service in Australian marks and from December 16 between Sydney and Japan on a weekly flight for the R.A.A.F. One was fitted with a ventral pannier for carrying spare engines and the service was extended to Tokyo on October 15, 1948. A few weeks later a machine captained by L. R. Ambrose made the first direct flight across the Indian Ocean from Perth to Johannesburg, reached on November 20 via the Cocos Islands and Mauritius. Mauritius was also a scheduled stop on the shuttle service operated by Skyways Ltd. in 1949 between Nairobi and Reunion with ex British Lancastrian 1s *VP-KFD* and *'GT*.

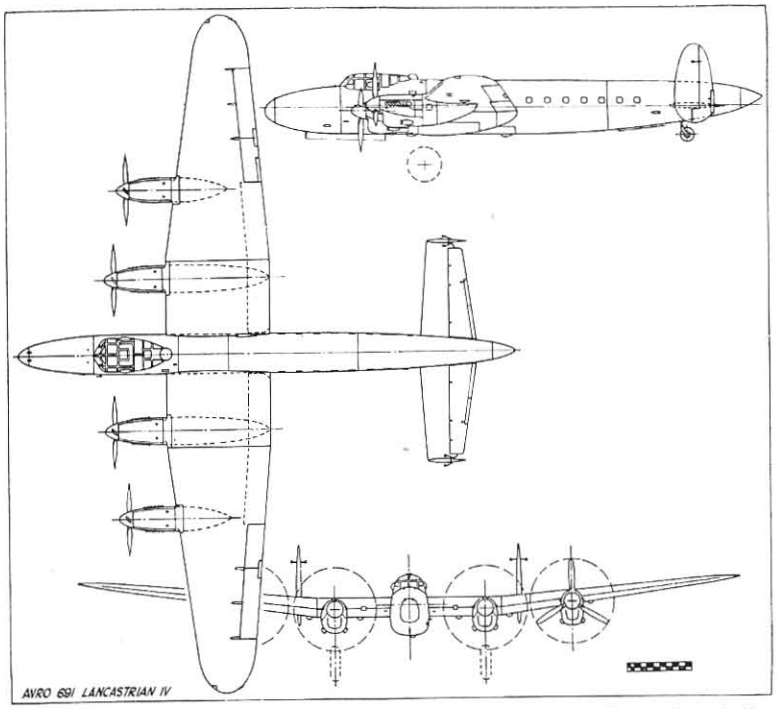
During the milk shortage of 1947 four Skyways Lancastrians were used for carrying milk in churns from Belfast/Nutts Corner to Liverpool/Speke and later, on the Berlin Air Lift, Flight Refuelling Ltd. was called in to specialise in the bulk delivery of petrol and diesel oil. Five former B.O.A.C./B.S.A.A.C. machines and four T.C.A. aircraft specially ferried from Montreal, were equipped at Ford, Sussex, with 2,500 gallon fuselage tanks, and the combined fleet made a total of 3,600 sorties, while five Skyways tankers made an additional 2,000. Their useful lives ended with the airlift and the veterans were flown back to Hurn, Dunsfold and Tarrant Rushton and broken up in 1951. An attempt to establish a charter company (Onzeair Ltd.) in Pakistan using two T.C.A. Lancastrians *CF-CMW* and *'MX*, and two Skyways aircraft *G-AJPP* and *G-AKJO*, ended with the loss of *'MW* on August 1, 1948 near the end of its Montreal–London–Karachi delivery flight.

Although primarily a transport type the Lancastrian C. Mk. 2 had a notable career as a long range navigation trainer with the Empire Air Navigation School, Shawbury. Typical of this work were the 36 day, 34,000 mile round the world flight made by *VM701* (Air Vice-Marshal Fiddament) ex Blackbushe on November 12, 1945; and the 12,500 mile Northolt–Wellington N.Z. flight by *VM726* (Sq. Ldr. J. Adams) March 6–8, 1946. The latter returned to Northolt 6 days 13 hrs. 15 min. later and was the first aircraft to circumnavigate the globe in less than a week.

The development of larger gas turbines called for test vehicles able to lift



R.A.F. Lancastrian C. Mk. 2 *VM704* equipped as test bed for Tudor power plants outboard and Shackleton inboard. (*Rolls-Royce Photo.*)



large quantities of fuel, and two surplus Lancastrian 1s from the civil production line were modified at Hucknall by Rolls-Royce Ltd. to take two 5,000 lb. s.t. Nene 1 turbojets in the outer nacelles. *VH742*, first flown at Hucknall by Sq. Ldr. R. T. Shepherd on August 8, 1946 was the first commercial type in the world to fly solely on jet power. After exhibition at the Radlett S.B.A.C. Show in September 1946 it made a record flight from London to Le Bourget on the Nenes alone in 50 min. at 263 m.p.h. on November 18 piloted by Shepherd and carrying Roy Chadwick as passenger. The return flight from Villacoublay on November 22 occupied only 49 min.

Similar conversions of two Lancastrian C. Mk. 2s to take two 5,000 lb. s.t. D.H. Ghost engines were made at Hatfield by the de Havilland Engine Co. Ltd. from drawings supplied by Rolls-Royce, but to accommodate the large Ghost nacelles, the ailerons and flaps were considerably shortened. *VM703*, first flown by John Cunningham and C. D. Beaumont on July 24, 1947, appeared at that year's Radlett S.B.A.C. Show and later completed rocket assisted take-off trials at Hatfield with two Walter 109-500 'cold' peroxide units under the fuselage. A second Ghost test bed *VM729* was used for after-burning research and together the two aircraft flew 425 hours, giving valuable jet experience in readiness for the Ghost Vampire and Comet.

Two other Lancastrian C. Mk. 2s were flown with Rolls-Royce Griffon piston engines inboard driving six bladed, contra-rotating airscrews on test for

the Shackleton, while *VM704* later flew with Tudor-type Merlin 600 power plants in the outer nacelles. Two others flew with Rolls-Royce Avon turbojets and the last, *VM733*, modified by Air Service Training Ltd., had two Armstrong Siddeley Sapphires outboard and first flew on January 18, 1950 during delivery from Hamble to Boscombe Down by F/Lt. P. Fowler.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire
Victory Aircraft Ltd., Malton, Toronto, Canada

Power Plants: Four 1,635 h.p. Rolls-Royce Merlin T.24/2 (later up-rated to T.24/4)
Four 1,750 h.p. Rolls-Royce Merlin 85
Four 1,635 h.p. Rolls-Royce Merlin 500

Dimensions: Span 102 ft. 0 in. Length 76 ft. 10 in.
Height 19 ft. 6 in. Wing area 1,297 sq. ft.

Weights and Performances:

	Mks. 1 and 2	Mks. 3 and 4	Nene test bed
Tare weight	30,426 lb.	30,220 lb.	—
All-up weight	65,000 lb.	65,000 lb.	62,570 lb.
Maximum speed	310 m.p.h.	315 m.p.h.	—
Cruising speed	230 m.p.h.	245 m.p.h.	265 m.p.h.*
Initial climb	750 ft./min.	950 ft./min.	—
Ceiling	30,000 ft.	25,500 ft.	25,000 ft.
Range	4,150 miles	2,820 miles	800 miles*

*On two Nene engines only.

Production:

(*a*) Exploratory conversions 1943–44

CF-CMS T.C.A.100, ex *R5727*, C. of A. 1.9.43, burned out at Dorval 6.45
CF-CMT T.C.A.101, ex *KB701* } Conversions by T.C.A. at Montreal, one
CF-CMU T.C.A.102, ex *KB702* } lost eastbound over the Atlantic 12.44

(*b*) By Victory Aircraft Ltd., Toronto 1944

CF-CMV T.C.A.103, ex *KB729*, to Flight Refuelling Ltd. 9.47 as *G-AKDO*
CF-CMW T.C.A.104, ex *KB730*, to Onzeair Ltd., Karachi as *AP-ACM*, crashed at Manipur, Pakistan 1.8.48
CF-CMX T.C.A.105, ex *FM184*, to Onzeair Ltd., Karachi
CF-CMY T.C.A.106, ex *FM185*, to Flight Refuelling Ltd. 1.48 as *G-AKDP*, crashed en route Berlin–Hamburg 10.5.49
CF-CMZ T.C.A.107, ex *FM186*, to Flight Refuelling Ltd. 3.48 as *G-AKDR*
CF-CNA T.C.A.108, ex *FM187*, to Flight Refuelling Ltd. 12.47 as *G-AKDS*

(*c*) Lancastrian C. Mk. 1s by A. V. Roe and Co. Ltd.

Twenty-three aircraft for the R.A.F. under Contract No. 4780 to Works Order 9126: *VB873* prototype, *VD238*, *VD241*, *VD253*, *VF145–VF148*, *VF152–VF156*, *VF160–VF167*, *VH737* and *VH742*

Twenty-one transferred to B.O.A.C. 1945 as follows: c/n 1172 *G-AGLF*, ex *VB873*, C. of A. 7.2.45, unnamed, Skyways Ltd. "Sky Diplomat" 5.46, beyond repair in Iraq 11.5.47; 1173 *G-AGLS*, ex *VD238* ex *PD141*, 9.3.45, "Nelson", scrapped at Hurn 1.51; 1174 *G-AGLT*, ex *VD241* ex *PD142*, 20.3.45, "Newcastle", scrapped at Hurn 1.50; 1175 *G-AGLU*, ex *VD253* ex *PD143*, 29.3.45, unnamed, beyond repair at Hurn 15.8.46; 1176 *G-AGLV*, ex *VF163*, 13.4.45, unnamed, Skyways Ltd. "Sky Lane" 5.46, temporarily *VP-KGT* in 1949, scrapped 3.52; 1177 *G-AGLW*, ex *VF164*, 26.4.45, "Northampton", scrapped at Hurn 1.51; 1178 *G-AGLX*, ex *VF165*, 14.5.45, unnamed lost in the Indian Ocean 23.3.46; 1179 *G-AGLY*, ex *VF166*, 29.5.45, "Norfolk", scrapped at Hurn 1.51; 1180 *G-AGLZ*, ex *VF167*, 2.6.45, "Nottingham", to QANTAS 11.47 as *VH-EAU*; 1181 *G-AGMA*, ex *VF152*, 11.6.45, "Newport", scrapped at Hurn 2.51; 1182 *G-AGMB*, ex *VF153*, 15.6.45, "Norwich", crashed at Singapore 27.8.48; 1183 *G-AGMC*, ex *VF154*, 21.6.45, unnamed, crashed at Sydney 2.5.46; 1184 *G-AGMD*, ex *VF155*, 29.6.45, "Nairn", to QANTAS 7.47 as *VH-EAS*; 1185 *G-AGME*, ex *VF156*, 3.7.45, "Newhaven", scrapped at Hurn 1.50; 1186 *G-AGMF*, ex *VF160*, 25.7.45, unnamed, crashed at Broglie, France 20.8.46; 1187 *G-AGMG*, ex *VF161*, 21.8.45, "Nicosia", scrapped at Hurn 1.51; 1188 *G-AGMH*, ex *VF162*, 28.8.45, unnamed, crashed Karachi 17.5.46; 1189 *G-AGMJ*, ex *VF145*, 11.9.45, "Naseby", scrapped at Hurn 1.51; 1190 *G-AGMK*, ex *VF146*, 20.9.45, "Newbury", scrapped at Hurn 1.51; 1191 *G-AGML*, ex *VF147*, 26.9.45, "Nicobar", to QANTAS 9.47 as *VH-EAT*; 1192 *G-AGMM*, ex *VF148*, 3.10.45, "Nepal", wrecked at Castel Benito 7.11.49

Note: G-AGMN to *'MY*, c/n 1193–1204, ex *VF149–VF151* and *VF137–VF144*, were intended for B.O.A.C. but not completed.

VH737 and *VH742*, ex *PD193* and *PD194*, were loaned to Rolls-Royce Ltd. Hucknall, in 1946 as flying test beds for the Nene 1 turbojet engines, see section (*g*).

(*d*) Lancastrian C. Mk. 2s for the R.A.F.

Thirty-three aircraft to Specification C.16/44 under Contract No. 5328 to Works Order 9199: *VL967–VL981*, *VM701–VM704*, *VM725–VM738*. Used by No. 24 Squadron, Bassingbourn and the Empire Air Navigation School, Shawbury

Civil conversions: *VL971/G-AKPY*, C. of A. 16.3.48, B.O.A.C. "Natal"; *VL972/G-AKPZ*, 9.3.48, B.O.A.C. "Nile"; *VL973/G-AKSN*, 9.5.49, Skyways Ltd. "Sky Consort"; *VL974/G-AKSO*, 6.4.49, Skyways Ltd. "Sky Kingdom"; *VL977/G-AKMW*, 23.12.47, B.S.A.A.C. "Star Bright", Skyways Ltd. "Sky Empire" 1949; *VL978/G-AKTC*, B.S.A.A.C. spares; *VL979/G-AKFI/G-AJPP*, 1.12.47, Skyways Ltd. "Sky Consort"; *VM737/G-AKRB*, 1.3.48, B.O.A.C. "Nyanza"; *VM738/G-AKTB*, 28.4.48, B.S.A.A.C. "Star Glory", to Flight Refuelling Ltd. 1949; *G-AKFH*, 23.10.47, Skyways Ltd. "Sky Scout", temporarily *VP-KFD* 3.48–4.49, burned out at Gatow, Berlin 26.6.49

(*e*) Lancastrian 3s

Eighteen aircraft, initially to B.S.A.A.C. order, under Contract No. 5820 to Works Order 9265: c/n 1279 *G-AGWG*, C. of A. 5.12.45, "Star Light", crashed in Bermuda 13.11.47; 1280 *G-AGWH*, 9.1.46, "Star Dust", lost in the

Andes 2.8.47; 1281 *G-AGWI*, 24.1.46; "Star Land", to Flight Refuelling Ltd. 1.49; 1282 *G-AGWJ*, 28.1.46, "Star Glow", crashed at Bathurst, Gambia 30.8.46; 1283 *G-AGWK*, 15.2.46, "Star Trail", crashed in Bermuda 5.9.47; 1284 *G-AGWL*, 13.2.46, "Star Guide", to Flight Refuelling Ltd. 1.49

With the absorption of B.S.A.A.C. by B.O.A.C. the remaining 12 were delivered as follows: c/n 1288 *G-AHBT*, C. of A. 23.8.46, Silver City Airways Ltd. "City of New York", Skyways Ltd. "Sky Ranger" 7.47; 1289 *G-AHBU*, 16.9.46, Skyways Ltd. "Sky Path", crashed at Nutts Corner 3.10.47; 1290 *G-AHBV*, 18.9.46, Silver City "City of Canberra", to Skyways Ltd. 3.49; 1291 *G-AHBW*, Silver City "City of London", to QANTAS 1.48 as *VH-EAV*; 1292 *G-AHBX*, 2.4.47, to Alitalia 2.48 as *I-AHBX* "Maestrale"; 1293 *G-AHBY*, 2.4.47, to Alitalia 11.47 as *I-AHBY* "Libeccio"; 1294 *G-AHBZ*, 6.11.46, Skyways Ltd. "Sky Ambassador", to Onzeair Ltd. 3.49 as *AP-ACQ*; 1295 *G-AHCA*, 6.11.46, Skyways Ltd., burned at Dunsfold 8.12.46; 1296 *G-AHCB*, 8.1.47, to Alitalia 7.47 as *I-AHCB* "Grocale"; 1297 *G-AHCC*, 12.12.46, Skyways Ltd. "Sky Chieftain"; 1298 *G-AHCD*, 10.1.47, B.S.A.A.C. "Star Valley", to Alitalia 12.47 as *I-AHCD* "Sirocco"; 1299 *G-AHCE*, 2.4.47, to Alitalia 8.47 as *I-DALR* "Borea"

(*f*) Lancastrian C. Mk. 4s for the R.A.F.

Eight aircraft under Contract No. 5666 to Works Order 9243: *TX283–TX290*

Civil conversions by Skyways Ltd.: *TX284/G-AKFF*, C. of A. 10.9.47, "Sky Ruler", B.S.A.A.C. "Star Flight" 1948, to Flight Refuelling Ltd. 1949; *TX285/G-AKLE* used for spares; *TX286/G-AKFG*, 29.9.47, "Sky Minister", B.S.A.A.C. "Star Traveller" 1948, to Flight Refuelling Ltd. 1949; *G-AKJO*, 25.10.47, "Sky Envoy", to Onzeair Ltd. 7.48

Civil conversions by A. V. Roe and Co. Ltd. for FAMA, Argentina: *TX288/LV-ACS*, c/n 1382, C. of A. 17.1.47; *TX287/LV-ACU*, 1402, 6.4.47; *TX289/LV-ACV*, 1403, 19.5.49. All transferred to V Brigada Aeria, one serialled *T-102*

(*g*) Lancastrian engine test beds

VH742 Converted at Hucknall, first flown 14.8.46 with two 5,000 lb. s.t. Rolls-Royce Nene 1 outboard

VH737 Second Nene conversion similar to above

VM703 Converted at Hatfield, first flown 24.7.47 with two 5,000 lb. s.t. de Havilland Ghosts outboard

VM729 Second Ghost conversion similar to above

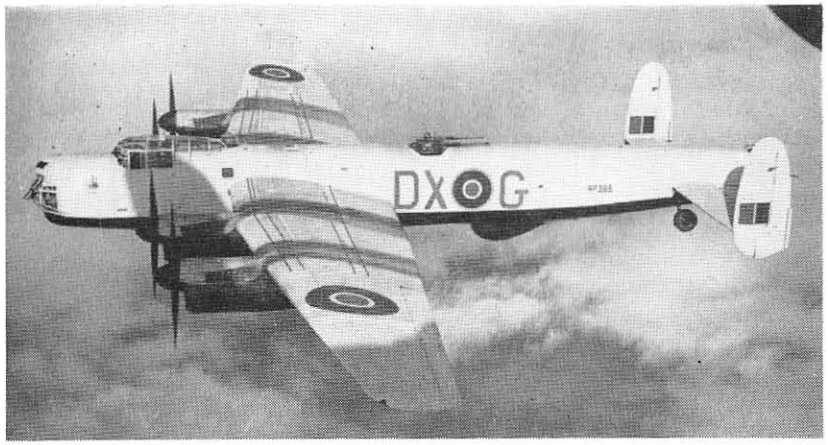
VM704 Flown with two 2,450 h.p. Rolls-Royce Griffon 57 inboard and two Merlin T.24/4 outboard. Later with two 1,770 h.p. Merlin 600s

VM728 Second Griffon conversion similar to above

VM732 Originally for Rolls-Royce Merlin exhaust tests, converted at Hucknall to take two Rolls-Royce Avons outboard and shown at Farnborough 7.9.48

VL970 Second Avon conversion similar to above

VM733 Converted by Air Service Training Ltd. to take two Armstrong Siddeley Sapphires outboard, first flown Hamble–Boscombe Down 18.1.50, still flying at Bitteswell 6.54



Lincoln B. Mk. 2 *RF385* of No. 57 Squadron.

Avro 694 Lincoln

In 1943 an improved Lancaster was designed for the Pacific War with better performance, heavier armament and very long range. Overall dimensions were increased, more powerful engines installed and the whole design so extensively modified that it emerged as a new type. The intention to call it the Lancaster IV when fitted with four 1,750 h.p. Rolls-Royce Merlin 85s, and Lancaster V with the Packard Merlin 68A equivalents, was dropped therefore in favour of new designations Avro 694 Lincoln 1 and 2 respectively.

The Lincoln anticipated Air Ministry Specification B.14/43 to which it was built and the unarmed prototype *PW925* first flew at Ringway, piloted by Capt. H. A. Brown, on June 9, 1944. Similar in structure to its predecessor, it used a standard Lancaster tail unit (with enlarged rudders) to speed production, but flush riveting gave place to the mushroom type and a sturdier Dowty undercarriage carried the extra weight. Merlin 85 engines drove Rotol three bladed airscrews and were arranged as detachable power units in low drag, armour plated cowlings with annular radiators of the type airtested in Lancaster VI *ND784/G* and T.C.A.'s civil conversion *CF-CMS*.

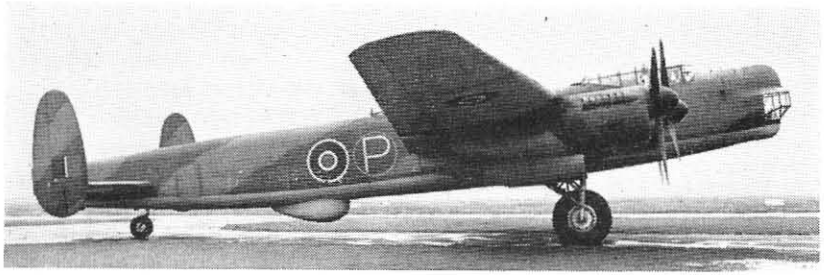
PW925 was fitted later with a Glenn Martin mid-upper turret, but subsequent prototypes *PW929* and *PW932* and all production Lincolns had the Bristol Type 17 Mk. II, with Boulton Paul F and D type in nose and tail, all mounting (in the Lincoln B. Mk. 1) twin 0·50 in. machine guns. Two 0·50 in. guns in the nose turret of the Lincoln B. Mk. 2 were remotely controlled by the bomb aimer, two others were in the tail and one in a ventral position. The mid-upper mounted two 20 mm. British Hispano cannon. Twelve Lincoln B. Mk. 1 were converted to Mk. 2 by Short Bros. and Harland Ltd. in 1947. The alternative fitment of H2S Mk. IIIG or IVA

radar bomb sights gave rise to two sub-variants, the Lincoln B. Mk. 2 (IIIG) and B. Mk. 2 (IVA).

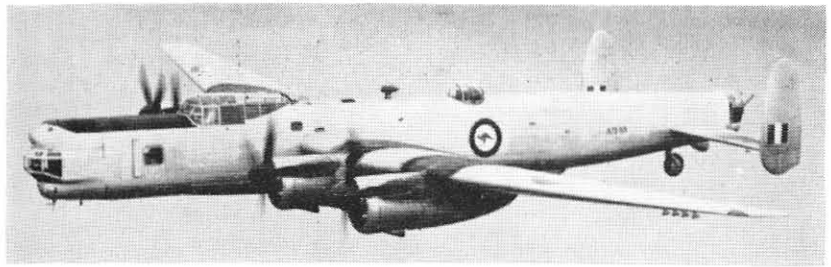
Range varied from 1,470 miles with 14,000 lb. bomb load to 4,450 miles with 3,000 lb. Flown by a crew of seven, it had the magnificent handling qualities of the Lancaster but came too late for service against the Japs. Contracts awarded to the Lancaster Group for 800 Lincolns were consequently cut back to a small number for use as standard heavy bombers in the postwar R.A.F. Production initiated by A. V. Roe and Co. Ltd. at Manchester and Yeadon was completed by Armstrong Whitworth.

Lincolns were first issued to No. 57 Squadron, East Kirkby, Lincs., and No. 44 Squadron, Mildenhall, for Service trials in September 1945 and the type made its first public appearance when B. Mk. 2 *RE325* was demonstrated at a Farnborough 'At Home' on October 29 that year. Three Lincolns which flew 20,000 miles from Scampton to Santiago, Chile, and back in October 1946 were the first of many globetrotters. Sixteen Lincolns of No. 617 Squadron flew nonstop Binbrook–Gander on July 23, 1947, flew over New York in formation, and visited Los Angeles and Canada before returning on September 9. No. 44 Squadron flew to Southern Rhodesia in June 1948; No. 97 to Singapore in the same year; and six from No. 9 Squadron took part in Exercise 'Sunrise' in the Canal Zone before paying a goodwill visit to Pakistan in October 1949.

All 20 Lincoln squadrons (of which 15 flew in mass formation at the Farnborough R.A.F. Display in July 1950), were normally U.K.-based but in March 1950 No. 97 Squadron, Waddington, was the first of several detached to Tengah, Singapore, for bombing operations against terrorists in Negri Sembilan. They performed a similar service in Kenya against the Mau Mau in 1954. Historically important as the R.A.F.'s last piston engined bomber, the Lincoln was completely replaced in front line service by 1955. The last in R.A.F. use were *RA685*, *RF398*, *RF461*, *RF505* and *RF570* which formed a Flight of No. 151 Squadron, Signals Command, Watton. They made a farewell flight over East Anglia on March 12, 1963 after which two went to Hullavington for preservation and the others to No. 23 M.U., Aldergrove, where the majority of their predecessors had been broken up.



The first prototype Lincoln *PW925*. (*Avro Photo.*)



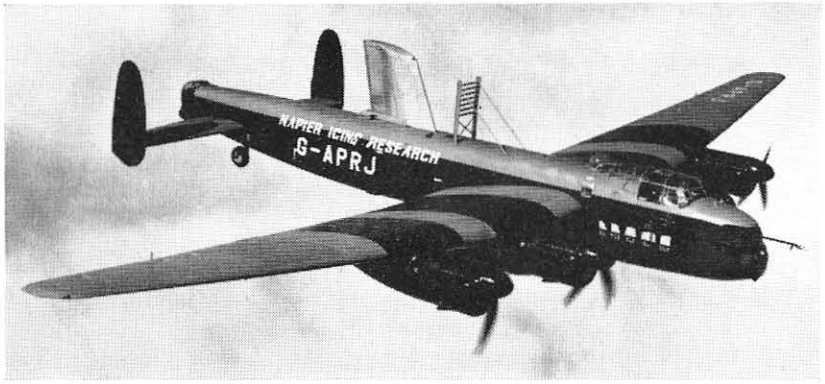
Royal Australian Air Force Lincoln Mk. 31(MR) *A73-55* with nose extension. (*R.A.A.F. Photo.*)

Lincolns modified for meteorological survey work used the revised type number Avro 712.

The Lincoln 3 was an Air-Sea Rescue project which appeared eventually in a much modified form as the Avro 696 Shackleton. The B. Mk. 4 announced in April 1947 was merely a B. Mk. 2 with Merlin 85s, the next designation being Lincoln B. Mk. 15, a Canadian version of the B. Mk. 1 laid down by Victory Aircraft Ltd. in 1946 after R.C.A.F. tests at Edmonton with *RE258* and *SX924*. All were scrapped in the factory excepting the first, *FM300*, which was completed as a Tudor 2 with Rolls-Royce Merlin 68 engines as a R.C.A.F. troop transport by A. V. Roe and Co. Ltd. who had taken over the Victory plant. Fifty-four examples of the Lincoln Mk. 30(B) were constructed at Melbourne by the Australian Government Aircraft Factory, five from British parts (the first flown on March 17, 1946), and the remainder entirely built in Australia. Twenty-four of the latter had Merlin 102s and 30 had Australian built Merlin 85s under the designation Lincoln Mk. 30A(B). The 18 Lincolns of No. 10 Squadron, Garbutt, were returned to the factory in 1952 to be fitted with a 6 ft. fuselage extension housing additional radar gear for anti-submarine work as Lincolns Mk. 31(MR). In 1961 all R.A.A.F. Lincolns were grounded and the majority flown to Archerfield, Brisbane, to be melted down. The last to fly was *A73-61*.

In March 1947 an R.A.A.F. Lincoln penetrated farther south than any previous Australian aeroplane to photograph a proposed explorers' base at Macquaue Island, Antarctica. Another named "Nyhuan" (Pathfinder) surveyed the site of the world famous Woomera missile range. The Australian Lincoln's main offensive opportunity was against Malayan terrorists and for this purpose No. 1 Squadron R.A.A.F. was based alongside the R.A.F. at Singapore. Several, including *A73-66*, were fitted with four rocket projectiles under each wing tip for strafing jungle hideouts. In a peaceful role, *A73-39* was used for rain making experiments in 1958.

The career of the British Lincoln paralleled that of the Lancaster and a number were operated by the Central Bomber Establishment, Marham, and the Empire Air Armament, Navigation and Radio Schools at Manby, Shawbury and Debden. Their names "Excalibur", "Crusader", "Thor II",



Napier Icing Research Lincoln *RF342/G-APRJ* with aerofoil test section in position on the fuselage. (*'Flight' Photo 39293S.*)



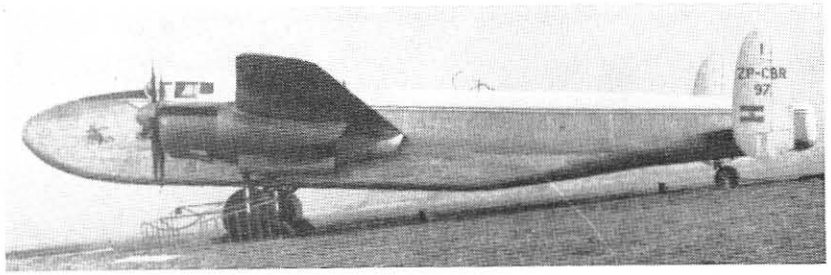
"Aries III" *RE367* of the Empire Air Navigation School, Shawbury, with Lancastrian nose and tail. (*'Flight' Photo 25077S.*)

"Aries II" and "Mercury II" perpetuated those of their illustrious forebears. During 1946–49 they made long distance liaison flights to the Commonwealth and U.S.A. to demonstrate the latest bombing tactics, defensive armament and navigation aids. "Aries II" with Lancastrian-type nose and tail, made a round trip to Australia October–December 1947 to make researches into the earth's magnetic field but in 1948 was destroyed by fire and replaced by "Aries III".

The Lincoln's performance at altitude and its ample accommodation for test equipment made it an ideal vehicle for flight testing the new generation of British turboprop engines. Other experimental Lincolns included *RF533* fitted in 1954 with a stepped canopy for observing rain erosion of a Javelin radome in the nose; *RA657* used to perfect Flight Refuelling Ltd.'s probe and drogue apparatus; *RE284* flown with a scale Brabazon undercarriage and *RF322* maintained by Eagle Aviation Services Ltd., Blackbushe, as a camera ship in succession to Lancaster *NX739*. *RE366* and *RF395* were converted into U. Mk. 5 target drones, and two (one in civil marks) were

converted for de-icing research in 1956 by the Napier Flight Development Establishment, Luton, and flown with 6 ft. specimen wing sections mounted vertically on top of the fuselage and wetted by a 36 nozzle spray mat fed from water tanks in the bomb bay.

The Argentine Air Force acquired 30 (12 ex-R.A.F. Lincoln B. Mk. 2s and 18 new aircraft) to supplement Lancasters of Air Regiment No. 1 and the first (serial *B-001*) was exhibited in Buenos Aires in October 1947. *B-003*, rebuilt at Langar, Notts., in 1948 with Lancastrian extremities and named "Cruz del Sud" for South Polar research flights with temporary civil marks *LV-ZEI*, was the first true Avro 695 Lincolnian. Paraguay also commissioned Field Aircraft Services Ltd. to convert Lincoln 2s *RF417*, *RE376* and *RF458* to the same standard and to fit ventral freight holds. With civil marks *ZP-CBP-96* to *'BS-98* they were intended for carrying meat, but were



ZP-CBR-97, second of the abortive Paraguayan Lincolnian freighters.

scrapped when the scheme fell through. *G-ALPF*, sole British aircraft of this kind, was converted by Airflight Ltd. at Langley (C. of A. June 22, 1949) from Lincoln 2 *RE290* and fitted with ventral pannier for use by Surrey Flying Services Ltd. on the Berlin Air Lift. After one freight sortie it was converted for the bulk uplift of fuel oil and made 45 tanker sorties before returning to Southend to be scrapped in 1952.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; Woodford Aerodrome, Cheshire; and Yeadon Aerodrome, Yorks.
Metropolitan-Vickers Ltd., Mosley Road Works, Manchester
Sir W. G. Armstrong Whitworth Aircraft Co. Ltd., Whitley, Coventry
Victory Aircraft Ltd., Malton, Ontario, Canada
The Australian Government Aircraft Factory, Fishermens Bend, Melbourne

Power Plants: (B. Mk. 1) Four 1,750 h.p. Rolls-Royce Merlin 85
Two 1,750 h.p. Rolls-Royce Merlin 85B and two 1,750 h.p. Rolls-Royce Merlin 66
(B. Mk. 2) Four 1,750 h.p. Packard Merlin 68, 68A or 300
(B. Mk. 4) Four 1,750 h.p. Rolls-Royce Merlin 85
(B. Mk. 15) Four 1,750 h.p. Packard Merlin 68A
(Mk. 30(B)) Four 1,750 h.p. Rolls-Royce Merlin 85
Four 1,750 h.p. Rolls-Royce Merlin 102

Dimensions: Span 120 ft. 0 in. Height 17 ft. 3½ in.
Length 78 ft. 3½ in.; with Lancastrian nose and tail 85 ft. 0 in.; Mk. 31(MR) 84 ft. 3½ in.
Wing area 1,421 sq. ft.

Weights: (B. Mk. 1) Tare weight 43,778 lb. All-up weight 82,000 lb.
(B. Mk. 2) Tare weight 44,148 lb. All-up weight 82,000 lb.

Performance: Maximum speed 295 m.p.h. at 15,000 ft.
Cruising speed 238 m.p.h. at 15,000 ft.
Initial climb 820 ft./min. Ceiling 22,000 ft.
Maximum range 3,570 miles

Production:

(*a*) **By A. V. Roe and Co. Ltd. at Manchester**

Three prototypes to Air Ministry Specification B.14/43: *PW925*, *PW929* and *PW932*, also 162 aircraft under Contract No. 1807: *RE227–RE268*, *RE281–RE288* (B. Mk. 1); *RE289–RE325*, *RE338–RE380*, *RE393–RE424* (B. Mk. 2). (*PW932* scrapped at Cranfield 1961)

(*b*) **By A. V. Roe and Co. Ltd. at Yeadon**

Six aircraft for the R.A.F. under Contract No. 3858: *SS713–SS714* (B. Mk. 1); *SS715–SS718* (B. Mk. 2)

(*c*) **By Metropolitan-Vickers Ltd.**

Seventy-nine aircraft under Contract No. 2221: *RA628–RA655* (B. Mk. 1); *RA656–RA658*, *RA661–RA693*, *RA709–RA724* (B. Mk. 2)

(*d*) **By Sir W. G. Armstrong Whitworth Aircraft Ltd.**

Two hundred aircraft under Contract No. 239: *RF329–RF370*, *RF383–RF427*, *RF440–RF485*, *RF498–RF539*, *RF553–RF577* (B. Mk. 2)

Sixty aircraft under Contract No. 4069: *SX923–SX958*, *SX970–SX993* (B. Mk. 2 modified to Mk. 4 after delivery)

Twenty-one aircraft under Contract No. 3388: *WD122–WD133*, *WD141–WD149* (B. Mk. 2).

Eighteen diverted to A. V. Roe for the Argentine under Works Order SALES 104 as *B-013* to *B-030*, c/n 1489–1506

(*e*) **By Victory Aircraft Ltd. at Malton, Ontario**

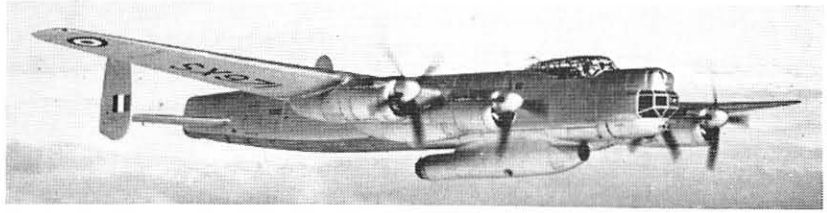
Six aircraft *FM300–FM305* laid down but not completed. *FM300* converted to Tudor 2, on charge at No. 1 Equipment Depot, Weston, Ontario 17.8.46 but remained stored in the Avro Canada works until at least 4.3.47

(*f*) **By the Australian Government Aircraft Factory**

Twenty-four Mk. 30(B): *A73-1* to *A73-24*. Thirty Mk. 30A(B): *A73-25* to *A73-54*. Eighteen conversions to Mk. 31(MR) reserialled *A73-55* to *A73-73*

(*g*) **Reconditioned by Short Bros. and Harland Ltd. at Belfast**

Twelve Lincoln B. Mk. 2 for the Argentine under Works Order SALES 104/17: *B-001* to *B-012*, Avro c/n *1405–1416*, ex *RE343*, *RE349–RE356*, *RE408–RE410*



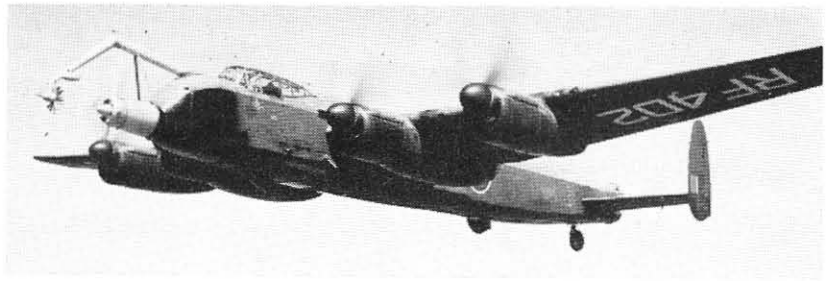
Lincoln B. Mk. 4 *SX971* with ventral mounted Rolls-Royce Derwent and retractable tail wheels.
(*Air Service Training Photo.*)

Service Use (Squadron codes in parentheses):

Bomber Command: Nos. 7(MG), 9, 12(PH), 15(LS), 35(TL), 44(KM), 49(EA), 50(VN), 57(DX), 61(QR), 83(OL), 90(WP), 97(OF), 100(HW), 101(SR), 115(KO), 116, 138(NF), 148(AU), 149(OJ), 192, 199, 207(EM), 214(QN), 245, 527, 617(KC). Other Units: No. 230 O.C.U., Air Sea Warfare Development Unit, Bomber Command Instructors' School, Central Bomber Establishment, Radio Warfare Establishment, Empire Air Armament School, Empire Test Pilots' School, Central Gunnery School, Radar Reconnaissance Flight, Radar Bombing School, No. 1426 Flight, Aden, No. 90 Group. To Australia for special trials: *RA638*, *640*, *644*, *648*, *RE258*, *259*, *339*, *418*, *RF403*, *423*

Named Lincolns:

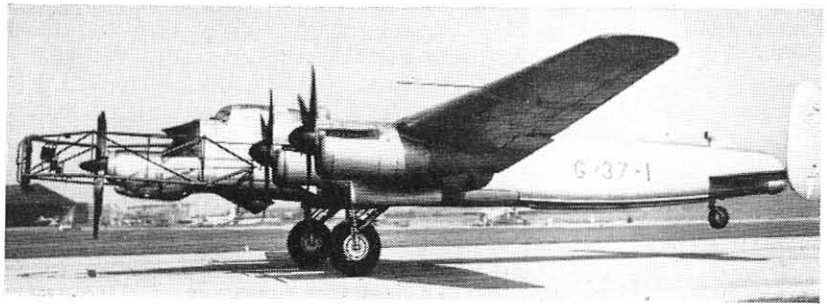
Aries II	*RE364*, Empire Air Navigation School, Shawbury; Lancastrian nose and tail; named 3.47 by Lady Coningham; to Singapore 7.3.47, non-stop Habbaniyah, Iraq–Shawbury 30.3.47, to South Africa 30.4.47, to Montreal 11.8.47, to New Zealand 20.10.47, to the Far East 27.1.48; destroyed by fire 1948
Aries III	*RE367*, replaced Aries II 12.48
Crusader	*RF498*, Central Bomber Establishment, Marham; to South Africa 26.10.46, to the Far East and Australasia 26.10.47, to South Africa 16.2.48, to Canada and U.S.A. 1.4.49, to *7021M*
Excalibur	*RF844*, Central Bomber Establishment, Marham; to the Far East, Australia and New Zealand 9.9.46
Mercury II	*RE414*, Empire Radio School, Debden, replacing Halifax VI "Mercury"; to Canada and U.S.A. 27.5.47, to the Far East and Australasia 22.1.48, to South Africa 19.9.48, to Canada 18.1.49
Thor II	*RF523*, Empire Air Armament School, Manby, replacing Lancaster "Thor I"; to Canada and U.S.A. 2.11.46, to the Far East 18.4.47, to Canada and U.S.A. 26.9.47, to South Africa 22.1.48, to New Zealand 10.5.48, to the Far East 18.1.49



Lincoln B. Mk. 2 *RF402* equipped for Napier Naiad turboprop icing trials, 1948. (*Napier Photo.*)



Lincoln B. Mk. 2 *RF403* with Armstrong Siddeley Python turboprops in the outer nacelles. (*Hawker Siddeley Photo.*)



The Tyne test bed Lincoln *G-37-1*. (*Rolls-Royce Photo.*)

Lincoln test beds:

RA643 Equipped as test bed for Bristol Phoebus turbojet 1947 by D. Napier and Son Ltd., Luton. Test engine mounted in bomb bay, extensive flying at Filton

RA716 Fitted by the Engine Division of the Bristol Aeroplane Co. Ltd. with two 2,400 h.p. Bristol Theseus 11s in outer nacelles, first flown at Filton by A. J. Pegg 17.2.47; at Martlesham 3.55 with Rolls-Royce Avons outboard; to No. 23 M.U., Aldergrove 4.57

RE339 Similar conversion with two 2,180 h.p. Bristol Theseus 21s (with heat exchangers) in outer nacelles

RE418 Second Theseus 21 conversion, loaned to R.A.F. Transport Command for scheduled services from Lyneham to the Middle East commencing 21.5.48

RF342 Fitted with Lancaster nose to continue Napier icing research begun by *RF402* (below), but equipped with four 200 gallon fuselage water tanks. Tested Beverley, Caravelle, Britannia and Comet wing tips. Civil as *G-APRJ* for flight to France 1.59; to Class B 1960 as *G-29-1* with Buccaneer tail test section; flown to College of Aeronautics, Cranfield 11.62 as *G-36-3* as spares for Lancaster *PA474*

RF368 Fitted with two Bristol Proteus in the outer nacelles

RF402 Converted by D. Napier and Son Ltd., Luton 1948 for icing trials with dummy Napier Naiad in the nose. Reverted to standard 9.56 for use by the Napier Icing Research Unit and flown with vertically mounted Beverley wing tip on top of fuselage, and 36-nozzle spray mat supplied from two 60 gallon water tanks. Allotted registration *G-APRP* 1.59, to spares for *RF342* in 1960

RF403 Fitted with two Armstrong Siddeley Pythons in outer nacelles by Air Service Training Ltd., Hamble

RF530 Flown at Luton 1946 with one 1,500 e.h.p. Napier Naiad turboprop in the nose

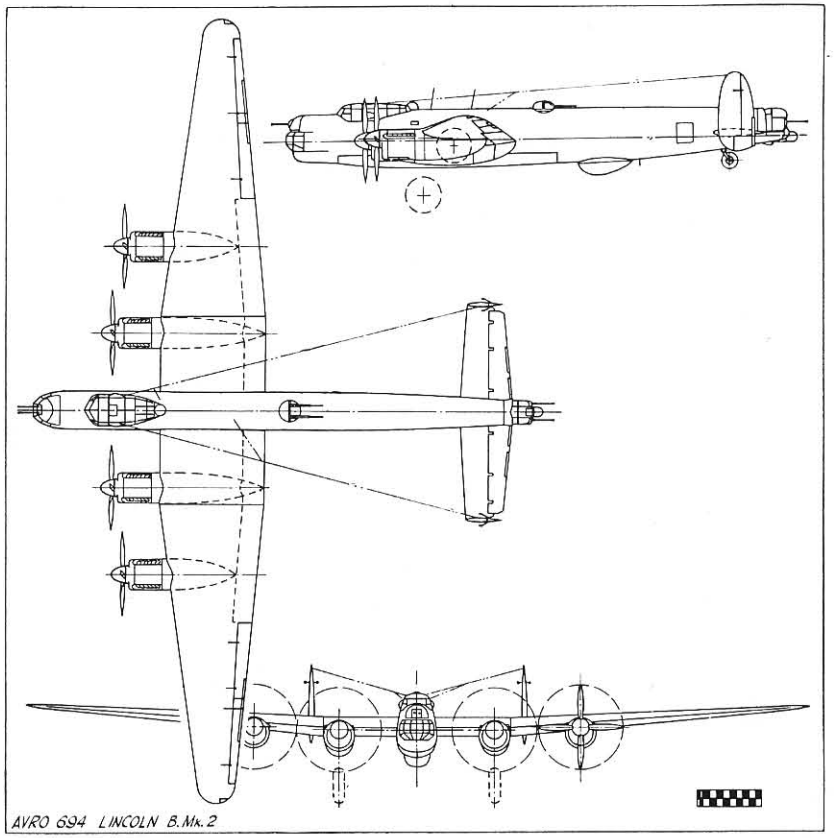
RF533 Flying laboratory at R.A.E. for development of radar and fire control systems

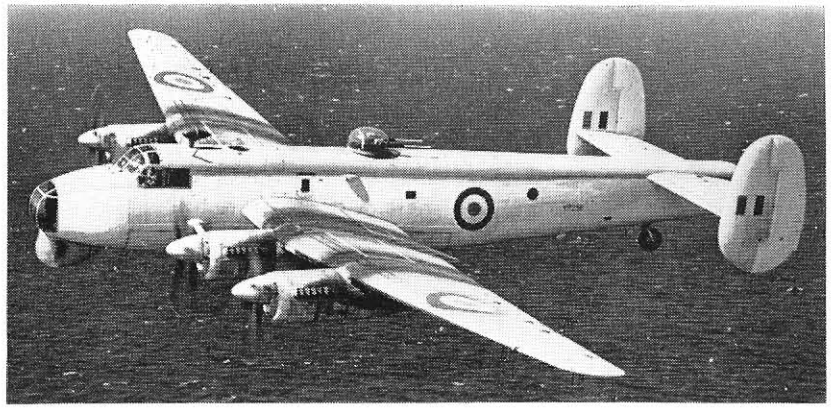
SX971 One Rolls-Royce Derwent fitted under the bomb bay by Air Service Training Ltd., Hamble, first flown 10.50 by F/Lt. P. R. Fowler. To counteract afterburner heat, the under fuselage was sheathed with stainless steel and twin retractable tail wheels fitted. Flown Farnborough–Hullavington for scrapping 4.12.56

SX972 Converted 6.49 as *RA716* (above) with two 3,200 h.p. Bristol Proteus in outer nacelles

SX973 Flown with one Napier Nomad 1 in the nose, trials completed 1954. A scheme to equip a further Lincoln test bed with two Nomads was allotted type number Avro 717

G-37-1 Converted ex *RF533* (above) and strengthened at Hucknall and flown with prototype 4,500 h.p. Rolls-Royce Tyne in the nose 1956 in connection with the Vickers Vanguard development programme. Flown at the Farnborough S.B.A.C. Show 9.9.56 on the Tyne alone, with all four Merlins feathered.





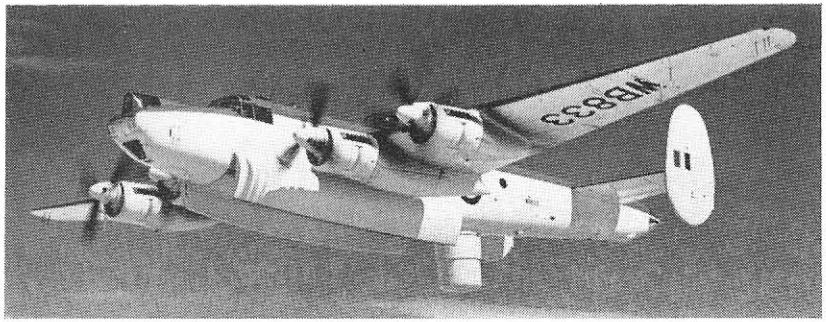
Avro 696 Shackleton M.R.1 *VP256* of R.A.F. Coastal Command. (*Avro Photo.*)

Avro 696 Shackleton

Planned originally as the anti-submarine Lincoln 3, the Shackleton was developed to meet a 1946 Coastal Command requirement for a long range maritime reconnaissance aircraft to replace lend-lease Fortress and Liberator machines handed back to the U.S.A. It used many Tudor assemblies and was fitted with the Lincoln mainplane and undercarriage, but the tailplane was moved from low to high wing position and the vertical surfaces enlarged. The new stressed skin fuselage was shorter, wider and deeper than the Lincoln's and power was supplied by two 2,450 h.p. Rolls-Royce Griffon 57As inboard and two 57s outboard, all driving D.H. Hydromatic six bladed, contra-rotating airscrews.

Conforming to Air Ministry Specification R.5/46 and known as the Shackleton G.R.1 (later M.R.1), the prototype *VW126* was first flown at Woodford by Avro chief test pilot J. H. Orrell on March 9, 1949. It was armed with a 20 mm. Hispano cannon on each side of the nose, two more in a Bristol B.17 mid-upper turret, and two 0·50 in. machine guns in the tail. Depth charges and/or bombs were housed in the bomb bay and the normal crew was ten. A large chin-type radome housed the A.S.V. scanner and *VW126* also had a flight refuelling intake under the tail. Two further prototypes *VW131* and *VW135* followed, and the first production aircraft *VP254* to Specification 42/46 flew on October 24, 1950. After entering service via No. 120 Squadron and No. 236 O.C.U., Kinloss, in February 1951 the Shackleton M.R.1 gradually replaced the Lancaster M.R.3 and formed the equipment of several new Coastal Command squadrons.

The second production batch, delivered in 1952, was fitted with Griffon 57A engines throughout, resulting in a widening of the outer nacelles and a change in designation to M.R.1A. Total M.R.1 and M.R.1A production was 77 aircraft. Operational experience showed the need for improved radar and



Shackleton M.R.1A *WB833* after modification to M.R.2 standard.

the ineffectiveness of the nose and tail armament. This was consequently removed from existing Shackletons, to supersede which the aerodynamically cleaner M.R.2 was produced with a 10 ft. streamlined nose housing twin 20 mm. cannons above a bomb aimer's position equipped with optically flat panels. A new radome with 360 degree scan was sited in a semi-retractable 'dustbin' aft of the bomb doors, a transparent tail cone was fitted, and twin retractable tail wheels replaced the single fixed unit. These improvements were first flown on the prototype *VW126* which served as the M.R.2 aerodynamic test vehicle. The next aircraft, *WB833*, a modified M.R.1A, first flew as an M.R.2 on June 17, 1952 and an early example *WL796*, complete with Saro Mk. 3 lifeboat, was flown at the 1953 Farnborough S.B.A.C. Show with three engines feathered.

The first of 69 Shackleton M.R.2s entered Coastal Command service in the U.K. and Malta later in 1952 after which long distance flights were made by No. 42 Squadron to South Africa and the Far East in April 1953; No. 206 Squadron made a 40,000 mile goodwill tour to Fiji in 1954; and four M.R.1As of No. 228 Squadron visited Brazil, Venezuela and Colombia in 1955. Those of No. 240 Squadron swept the Pacific during atomic tests at Christmas Island and Malta-based Shackletons were used as troop transports during the intervention in Egypt in November 1956. When fitted for meteorological survey the Shackleton M.R.2 qualified for type number Avro 713.

The withdrawal of the last Sunderlands created a need for a modernised Shackleton and work began on the M.R.3 version (Avro 716) in 1954. Similar in appearance to the M.R.2, it was equipped with a tricycle undercarriage and duplicated landing wheels; a modified mainplane with revised planform; improved ailerons; wing tip auxiliary tanks; and clear vision flight deck canopy. Twin nose-mounted 20 mm. cannons were reintroduced but the mid-upper turret was deleted in favour of eight rocket projectiles or sonobuoys under the wings.

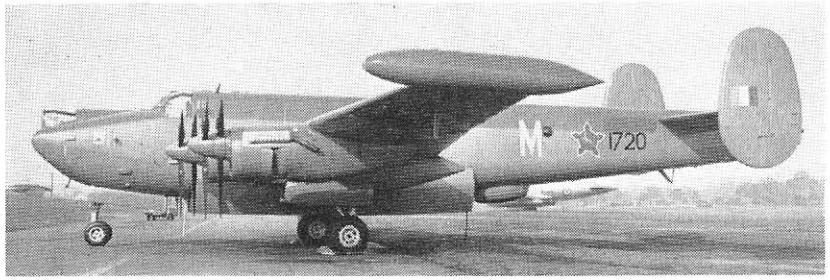
The M.R.3 could remain airborne for 18 hours, or in special circumstances 24 hours, so that it was necessary to carry a duplicated crew and provide a sound proofed ward room for off duty periods. The link with naval tradition

was strengthened by painting all Shackletons in battleship grey. *WR970*, the first M.R.3, flew on September 2, 1955 and appeared at that year's S.B.A.C. Show but contracts were cut back in 1956 and the first machines did not reach the squadrons until 1957. From bases in Northern Ireland, S.W. England, Gibraltar and Malta the M.R.3s settled down to unpublicised, unspectacular but incessant patrolling of the sea lanes and in February 1959 aircraft of No. 206 Squadron (F/Lt. D. R. Foster) remained airborne for the record time of 24 hrs. 21 min. during a patrol to the Canaries. In November 1962 three M.R.3s of No. 120 Squadron took part in Exercise Main Run III and made a goodwill tour of the Caribbean.

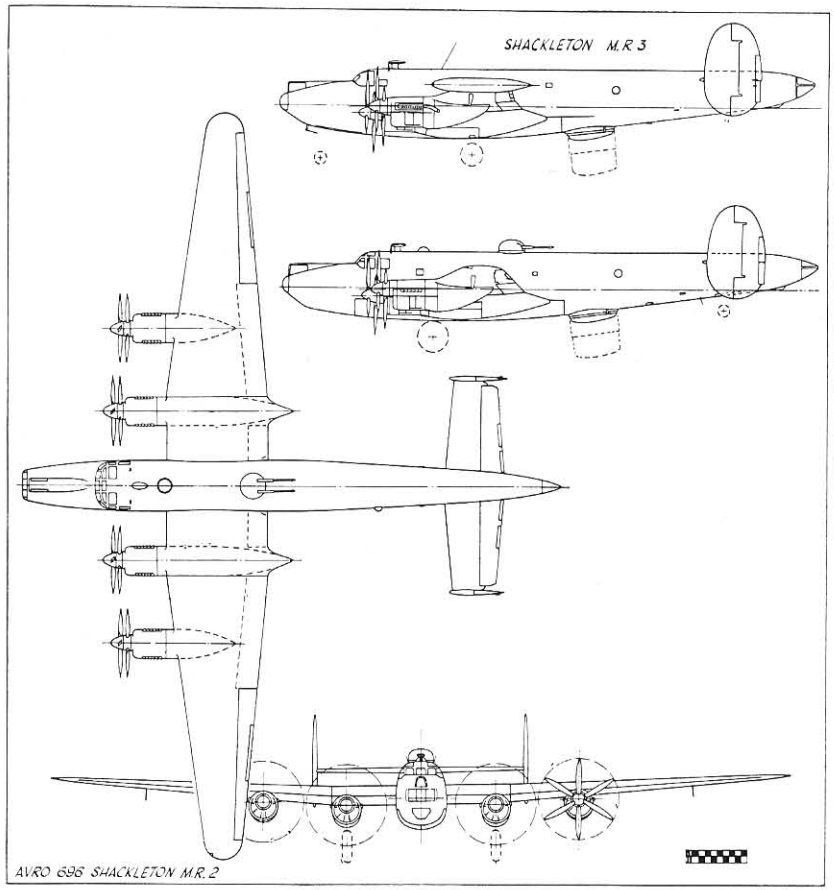
A visit to Durban by four Shackleton M.R.2s of No. 204 Squadron in June 1955 for a South African air-sea exercise resulted in eight M.R.3s from the initial production batch being supplied to the S.A.A.F. in the face of strong American competition. The first two were handed over at Woodford on May 16, 1957 and after crew training at St. Mawgan and a joint tactical exercise over the North Sea with Coastal Command, were flown to the D.F. Malan Airfield, near Cape Town, to equip No. 35 Squadron.

Although largely superseded by the M.R.3 with its improved submarine plotting equipment, the earlier marks continued in service as support aircraft and a number of elderly Shackleton M.R.1 and 1As were modified internally to reproduce the radio and navigational layout of the M.R.3 under the designation T. Mk. 4 for use by the Maritime Operational Training Unit, Kinloss (code MOTU). Additionally a number of M.R.2s were fitted with M.R.3 navigation and offensive equipment as the Shackleton M.R.2C. This mark equipped No. 205 Squadron, F.E.A.F., at Singapore in 1962.

Following the examples of previous Avro 'heavies', the Shackleton was also used experimentally. At least one, *WL789*, was flown at St. Mawgan in 1954 with a MAD 'stinger' tail; and one M.R.1 was equipped, but did not fly, as the Avro 717 engine test bed with two 3,135 h.p. Napier Nomad 2 engines in the outer nacelles. A production version, to be known as the Avro 719 Shackleton M.R.4 with four Napier Nomad E.145 engines, was not built. The majority of surplus machines were, however, flown to No. 23 M.U., Aldergrove, and scrapped in 1962.



South African Air Force Shackleton M.R.3 *1720*, c/n 1520.



SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire

Power Plants: (M.R.1) Two 2,450 h.p. Rolls-Royce Griffon 57 and two Griffon 57A
(Other marks) Four 2,450 h.p. Rolls-Royce Griffon 57A

Dimensions, Weights and Performances:

	Shackleton M.R.1	Shackleton M.R.2	Shackleton M.R.3
Span	120 ft. 0 in.	120 ft. 0 in.	119 ft. 10 in.
Length	77 ft. 6 in.	87 ft. 3 in.	92 ft. 6 in.
Height	17 ft. 6 in.	16 ft. 9 in.	23 ft. 4 in.
Wing area	1,421 sq. ft	1,421 sq. ft.	1,421 sq. ft.
Tare weight	—	—	57,800 lb.
All-up weight	—	86,000 lb.	100,000 lb.
Maximum speed	—	—	302 m.p.h.
Cruising speed	—	—	260 m.p.h.
Initial climb	—	—	850 ft./min.
Ceiling	—	—	19,200 ft.
Range	—	—	4,215 miles*

*At 200 m.p.h. at 1,500 ft.

Production:

Prototypes: *VW126*, *VW131* and *VW135* to Air Ministry Specification 5/46 (*VW126* later aerodynamic test vehicle for Shackleton M.R.2, scrapped at No. 23 M.U., Aldergrove 1957)

Shackleton M.R.1: Twenty-nine aircraft to Specification 42/46, *VP254–VP268*, *VP281–VP294*

Shackleton M.R.1A: Forty-eight aircraft built at Chadderton, *WB818–WB837*, *WB844–WB861*, *WG507–WG511*, *WG525–WG529*

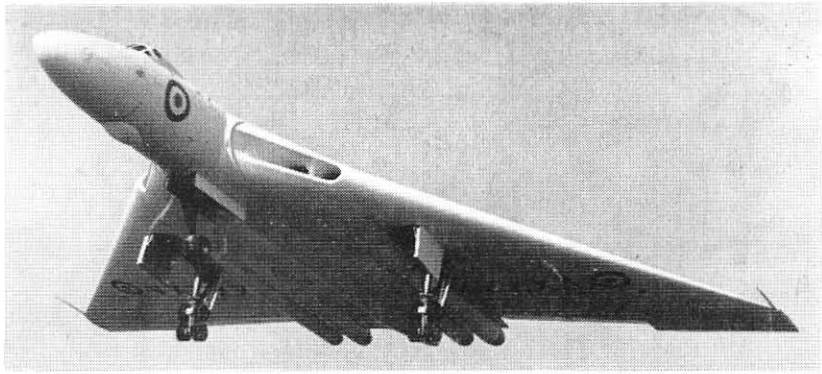
Shackleton M.R.2: Fifty-nine aircraft built at Chadderton, *WG530–WG533*, *WG553–WG558*, *WL737–WL759*, *WL785–WL801*, *WR951–WR969*

Shackleton M.R.3: Thirty-four aircraft built at Chadderton, *WR970–WR990*, *XF700–XF711*, *XF730*. (*WR970*, first flown 2.9.55, crashed at Foolow, Derbyshire 7.12.56, Avro test pilot J. B. Wales and crew killed)

Shackleton M.R.3: Eight aircraft for the South African Air Force, serials *1716–1723*, c/n 1526–1533

Service Use: (Individual aircraft often served with so many different squadrons that it is only possible to quote representative serial numbers)

Coastal Command Squadrons. No. 42: *WG510*, *WL737*, *WR952*. No. 120: *VP259*, *WB828*, *WG511*, *WL745*, *WR987*, *XF703*. No. 201: *WR975*, *XF707*. No. 203: *WB860*, *WG507*, *WR973*, *XF704*. No. 204: *VP287*, *WB850*, *WG528*, *WL751*, *WR951*. No. 206: *WB826*, *WG508*, *WL752*, *WR982*, *XF702*. No. 210: *WG555*, *WL797*, *WR971*, *XF700*. No. 220: *VP257*, *WB821*, *WL737*, *WR969*. No. 224: *VP256*, *WB852*, *WG532*; *WL741*. No. 228: *WG557*, *WR959*. No. 236: *VP268*, *WB828*. No. 240: *VP287*, *WB834*, *WG529*, *WL738*. No. 269: *VP255*, *WB818*, *WG509*, *WL746*. Overseas Squadrons. No. 37: *WG556*, *WL744*. No. 38: *WL740*, *WR954*. No. 205: *VP291*, *WB825*, *WG525*, *WL750*. No. 35 Squadron S.A.A.F.: *1716–1723*. Training. No. 236 O.C.U. (later M.O.T.U.): *VP263*, *WB830*. Air Sea Warfare Development Unit: *VP288*, *WB856*, *WG553*, *WL789*



VX777, the second prototype Avro 698 Vulcan with four Bristol Olympus turbojets. (*Bristol Photo.*)

Avro 698 Vulcan

Developed to a 1947 Air Staff requirement calling for a high altitude bomber to carry a nuclear warload at speeds approaching Mach 1, the Vulcan was the world's first large delta wing aircraft. Radical departure from convention enabled Roy Chadwick to design an aircraft which met an exacting specification yet at the same time was comparatively small and landed relatively slowly. Regrettably he did not live to see the tender accepted on November 27, 1947 or the completion of the design in the following September.

Of all-metal, stressed skin construction, the wing was some 7 ft. thick at the root end enabling drag to be kept to a minimum by enclosing engines, undercarriage, fuel and bomb load entirely within it. Trailing-edge flaps were unnecessary as landings were made at high angles of attack and defensive armament was neither needed nor fitted. Although unusual in appearance the Vulcan was structurally orthodox with two-spar mainplane, backward retracting nose wheels, forward retracting eight wheel bogie main units, and turbojets grouped close to the centre line. A conventional rudder was hinged to a swept fin but the other controls consisted of two pairs of ailerons and elevators on the trailing edge of the wing, with gate-type air brakes extending above and below. A braking parachute was fitted as standard.

Due to the unavailability of the Bristol Olympus turbojets for which it had been designed, Vulcan prototype *VX770* was completed with four 6,500 lb. s.t. Rolls-Royce Avon R.A.3s and first flown on August 30, 1952 by Avro chief test pilot Wing Cdr. R. Falk, who startled the aviation world by rolling it at the Farnborough S.B.A.C. Show a few days later. Such success derived from Avro's far sighted test programme with five small Avro 707 delta wing research aircraft which were, in effect, third scale models. They gave valuable

data on the Vulcan's probable flight characteristics, and two of them—the all-red Avro 707A *WD280* and all-blue Avro 707B *VX790*—emphasised the docility of deltas by flying a patriotic formation with the all-white Vulcan prototype during its S.B.A.C. debut. *VX770* reappeared at the 1954 Show with 8,000 lb. s.t. Armstrong Siddeley Sapphires and in 1957–58 with Rolls-Royce Conways.

The long range Vulcan 'V Bomber' was ordered into quantity production for the R.A.F. before the prototype had flown and production models (commencing *XA889*, first flown on February 4, 1955), were powered by four 9,750 lb. s.t. Bristol Olympus (first fitted to the second prototype *VX777*, first flown September 3, 1953) and were made slightly longer in the nose to avoid the need for shortening the nose leg prior to retraction. Boscombe Down trials showed that application of g at altitude could initiate buffeting which could lead to fatigue failure of the outer wings. In October 1955 therefore *VX777* was flown with leading edge sweepback reduced from 52 to 42 degrees at half span but increased further outboard. The few existing Vulcans were immediately modified in this way and commencing *XA890*, had extended engine nacelles.

Designated Vulcan B. Mk. 1 and delivered with progressively more powerful Olympus engines culminating in the 12,000 lb. s.t., the new deltas entered service with No. 230 O.C.U. in May 1956 and No. 83 Squadron in July 1957. Planned re-equipment was completed in 1960 when Nos. 101 and 617 also received the Vulcan B. Mk. 1.

During the first overseas Vulcan flight, *XA897* flew from Boscombe Down to Melbourne via Aden and Singapore on September 9, 1956 in 23 hrs. 9 min., but its tragic crash on final approach to London Airport, at the end of the flight on October 1, marred an impressive performance. In March 1958 *XA908* toured the Central African Federation.

The advent of the powerful 16,000 lb. s.t. Olympus (flown in Vulcan B. Mk. 1 *XA891* at the 1958 Farnborough S.B.A.C. Show) made possible the much more advanced Vulcan B. Mk. 2 with increased span and intended as a launching platform for the Avro Blue Steel 'stand-off' bomb or the Douglas Skybolt missile. Best use of the increased power was made by reducing the thickness/chord ratio of the wing extremities and further increasing the compound taper of the leading edge. Buffeting limitations were removed by fitting elevons in place of conventional ailerons and elevators. A Rover auxiliary power plant made the Mk. 2 independent of outside services and the effective range was extended by providing for air refuelling from Vickers Valiant tankers. The second prototype *VX777* became the B. Mk. 2 aerodynamic test vehicle and first flew with the new wing and toed-out jet pipes for the later Olympus engines on August 31, 1957.

The first production Vulcan B. Mk. 2 *XH533* flew in August 1958 and deliveries began in 1960 to Nos. 83 and 101 Squadrons whose B. Mk. 1 aircraft were then taken over by Nos. 44 and 61.

The power of the B. Mk. 2 was gradually increased until the 20,000 lb. s.t.



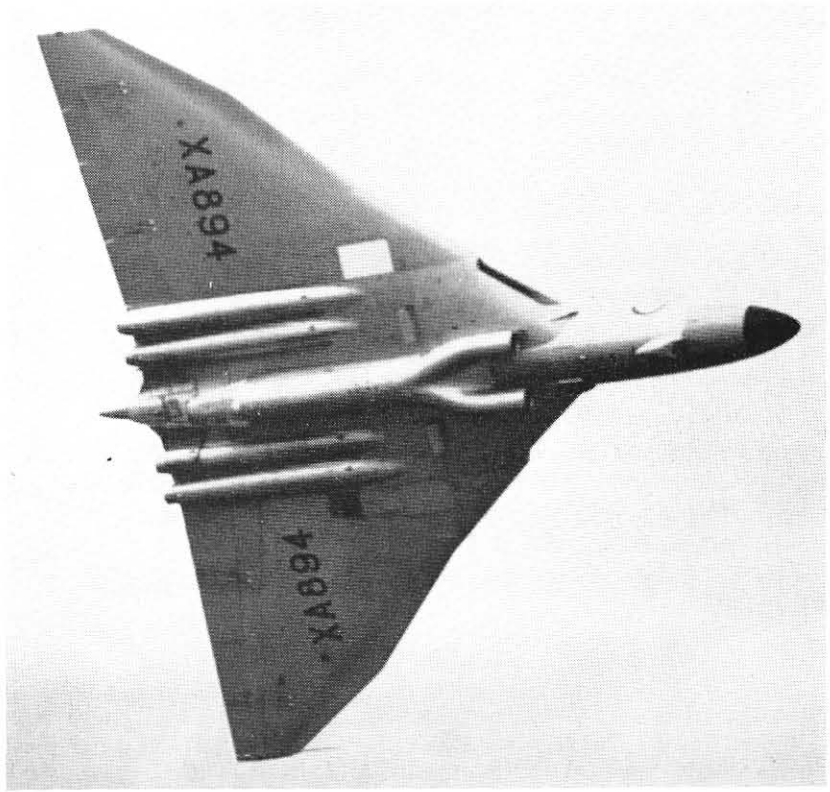
Vulcan B. Mk. 1 *XA889* with modified leading edge plan form. (*Avro Photo.*)

Olympus raised the top speed and operating altitude to the aerodynamic limits of the airframe. One aircraft went to Edwards Air Force Base in the U.S.A. in July 1961 to check the compatibility of the Vulcan and Skybolt electrical systems, but after that missile was abandoned in 1963, Blue Steel became the standard war load. It was first fitted to the 15th production Mk. 1 aircraft *XA903* and shown publicly at the 1962 S.B.A.C. Show on *XL361*. The Service development trials were conducted by No. 617 Squadron, Scampton, which fired the first training rounds at Woomera late in 1963. With fighter-like manœuvrability and able to release Blue Steel hundreds of miles from the target, the Vulcan B. Mk. 2 is one of the finest transonic medium bombers in service anywhere and a formidable deterrent.

Many spectacular long distance flights with air refuelling emphasised the Vulcan's incredible ability to reach remote places of the earth in less than a day, as for example the 8,500 mile nonstop, 17½ hour U.K.–Karachi flight by a No. 617 Squadron aircraft in April 1961; U.K.–Gan nonstop a month later; Scampton–Sydney nonstop in 20 hrs. 3 min. in July 1961; the 3,674 miles London–Aden point to point record by a Vulcan of No. 101 Squadron in 6 hrs. 14 min. on March 30, 1962; and Waddington–Perth W.A. nonstop by three aircraft of No. 101 Squadron in July 1963. Others took part in Operation Skyshield II in October 1961 and Western Ranger flights to the U.S.A. One each from Nos. 27, 83 and 617 Squadrons, Scampton, flew to the Antipodes in November 1962 to fly past at the Commonwealth Games and to participate in the R.N.Z.A.F. 25th Anniversary celebrations. On the return trip No. 617 Squadron's machine established a Goose Bay–Scampton record of 3 hrs. 46 min. at an average speed of 656 m.p.h.

After the destruction of the Conway R.Co.7 test bed *VX770* during a high

speed run at the Battle of Britain Display at Syerston in September 1958, a 1,000 hour endurance programme with the R.Co.11 was carried through at Hucknall in *XA902*. This aircraft was used later for Rolls-Royce Spey development and flew from Hucknall on October 12, 1961 piloted by Rolls-Royce chief test pilot J. Heyworth with Conways fitted outboard and the Rolls-Royce Spey by-pass engines (for the D.H.121, B.A.C. One-Eleven and Buccaneer S.2) inboard. Specially instrumented, *XA894* flew on the power of five Olympus engines, the fifth (mounted for test purposes in an underslung pod with bifurcated air intake) being the supersonic version for the T.S.R.2 and Sud/B.A.C. Concorde. After 100 hrs. of test flying *XA894* was burned out on the ground at Filton on December 3, 1962. Other routine Bristol Siddeley engine development flying took place in *XH557*.



XA894 with supersonic Bristol Olympus test engine in ventral pod with bifurcated air intake. (*S. P. Peltz Photo.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire; restyled the Avro-Whitworth Division of Hawker Siddeley Aviation w.e.f. July 8, 1963

Power Plants: (First prototype)
Four 6,500 lb. s.t. Rolls-Royce Avon R.A.3
Four 8,000 lb. s.t. Armstrong Siddeley Sapphire
Four 15,000 lb. s.t. Rolls-Royce Conway R.Co.7
(Vulcan B. Mk. 1)
Four 9,750 lb. s.t. Bristol Olympus
Four 11,000 lb. s.t. Bristol Olympus
Four 12,000 lb. s.t. Bristol Olympus
Four 13,500 lb. s.t. Bristol Olympus
(Vulcan B. Mk. 2)
Four 17,000 lb. s.t. Bristol Olympus 201
Four 20,000 lb. s.t. Bristol Olympus 301

Dimensions, Weights and Performances:

	Vulcan B. Mk. 1	Vulcan B. Mk. 2
Span	99 ft. 0 in.	111 ft. 0 in.
Length	97 ft. 1 in.	99 ft. 11 in.
Height	26 ft. 6 in.	27 ft. 1 in.
Wing area	3,554 sq. ft.	3,964 sq. ft.

Production:

(*a*) **Prototypes**

VX770, first flown with Avons 30.8.52, later with Sapphires and Conways; crashed at Syerston, Notts. 14.9.58. *VX777* first flown 3.9.53, later became aerodynamic test vehicle for the Vulcan B. Mk. 2

(*b*) **Vulcan B. Mk. 1**

Aircraft which have so far appeared in official photographs or at public displays suggest the following ranges: *XA889–XA913*, *XH475–XH483*, *XH497–XH506* and *XH532*

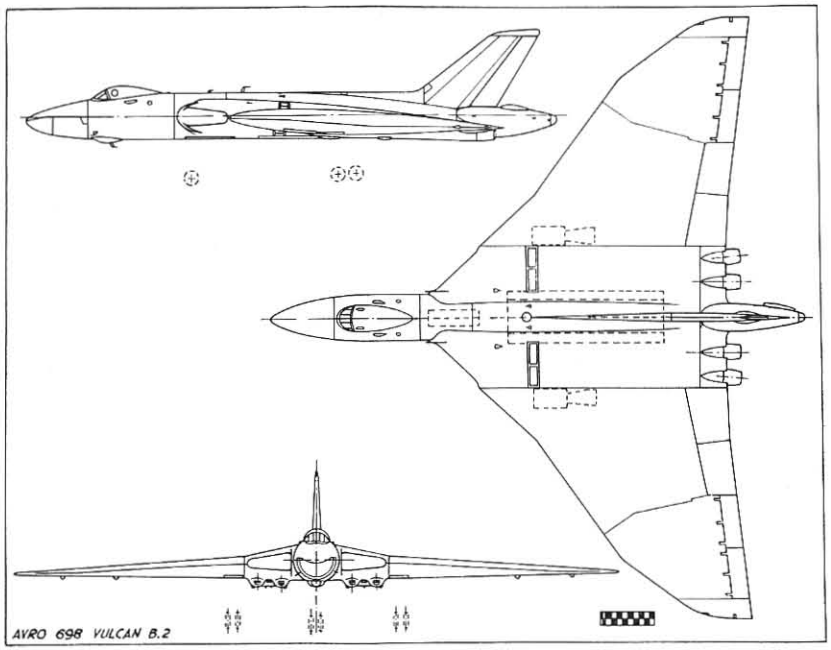
(*c*) **Vulcan B. Mk. 2**

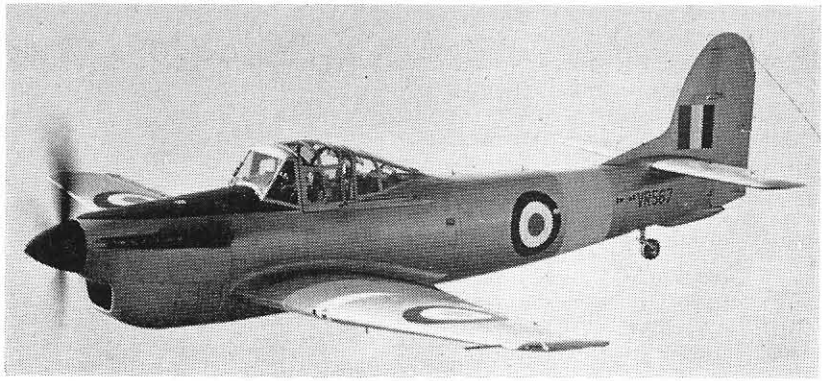
Commencing *XH533* and continuing, with extensive serial gaps, in the *XJ*, *XL* and *XM* series

Service Use: The following information has appeared in the Press.

Vulcan B. Mk. 1 and 1A Squadrons, Nos. 44, 61, 83 (Scampton), 101 (Waddington) and 617 (Scampton). Also No. 230 O.C.U. (Finningley)

Vulcan B. Mk. 2 Squadrons, Nos. 9, 12 (Coningsby), 27, 35 (Coningsby) 50 (Waddington), 83 and 617 (Scampton). Also No. 230 O.C.U. (Finningley)





Avro 701 Athena T. Mk. 2 *VR567*. (*Avro Photo.*)

Avro 701 Athena

Designed by S. D. Davies, the Athena T. Mk. 1 was a three seat advanced trainer with turboprop engine built to Air Ministry Specification T.7/45. Intended to replace the Percival Prentice as the standard R.A.F. basic trainer, it was an all metal, low wing monoplane which used the same aerofoil section as the Hawker Tempest in order to reproduce fighter-style handling qualities. Work began in March 1947 but after the first fuselage and wing structure had gone to Farnborough for strength tests, changing requirements of R.A.F. Training Command and non-availability of turbine engines led to the replacement of the original Specification by T.14/47 stipulating a change of power plant to the 1,280 h.p. Rolls-Royce Merlin 35, large stocks of which were held in store. Considerable redesign resulted in the Athena T. Mk. 2 on which the mainplane had been moved forward 27 inches to compensate for the greater weight of the piston engine.

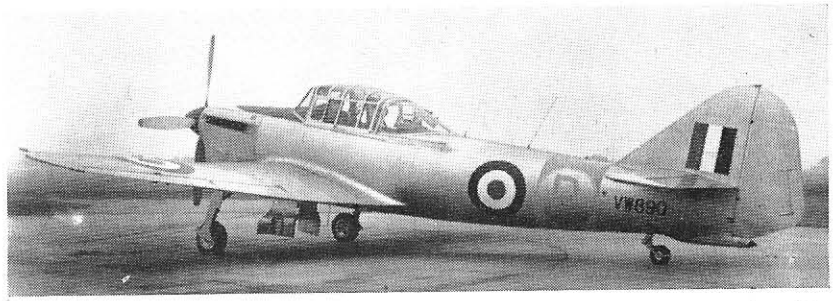
Nevertheless work continued at Manchester on the installation of Armstrong Siddeley Mamba and Rolls-Royce Dart gas turbines in three Mk. 1 airframes. These small diameter engines gave a much improved view over the nose but required a large diameter jet pipe ejecting through the fuselage side aft of the starboard wing root on the Mamba powered *VM125* and *VM132*, and under the fuselage on the Dart engined *VM129*. *VM125* was first flown at Woodford on June 12, 1948 by J. H. Orrell.

The centre section of the T. Mk. 2 housed an inward retracting Lockheed undercarriage, main fuel tanks, ·303 in. Browning gun, 300 rounds of ammunition and a G.45B camera gun. It was also made immensely strong to minimise damage in the event of a wheels-up landing and was equipped with attachment points for bomb racks or 45 gallon drop tanks as well as access doors to the internal engineering. Although provision was made for folding wings they were not built as the naval requirement was withdrawn before the

first Athena flew. Engine cooling was by beard-type Morris radiator, and a target-towing point was situated under the tail.

Delivery of two Merlin powered Athena T. Mk. 2 prototypes *VW890* (first flown on August 1, 1948) and *VW892* to Boscombe Down for performance tests, and tropical trials at Khartoum with *VW890*, was followed by evaluation of two production aircraft *VR566* and *VR567* at the Central Flying Establishment in October 1949. Whereas the first and third prototype T. Mk. 2s and all the turboprop machines had triangular fins and small unbalanced rudders, the second T. Mk. 2 *VW891* was fitted with a balanced rudder of greater area hinged to a larger fin. This rudder was a feature of all production aircraft but with fin cut back to give the tail unit a tall angular appearance. The canopy was also shortened by moving the radio forward and eliminating the third seat.

The Athena T. Mk. 2 replaced the Harvard for armament training at the R.A.F. Flying College, Manby, for which purpose provision was made for two 60 lb. rocket projectiles under each wing. Production was abandoned after the construction of 15 aircraft, but one machine was given temporary civil status as *G-ALWA* in February 1950 for a demonstration tour of India. It returned to Croydon on May 13, reverted to the Ministry of Supply as *VR569* and was demonstrated at the Farnborough S.B.A.C. Show in the following September by Avro test pilot J. Nelson.



Athena T. Mk. 2 first prototype *VW890* with the original canopy and tail unit. (*Crown Copyright Reserved.*)



Second prototype *VW891* with increased fin and rudder area. (*Crown Copyright Reserved.*)



The Mamba powered Athena T. Mk. 1 *VM125*. (*Avro Photo.*)



The Athena T. Mk. 2 civil demonstrator *G-ALWA*/*VR569*, c/n 1519. (*Avro Photo.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire

Power Plants:
(T. Mk. 1) One 1,010 h.p. Armstrong Siddeley Mamba 1
(T. Mk. 1A) One 1,400 h.p. Rolls-Royce Dart 1
(T. Mk. 2) One 1,280 h.p. Rolls-Royce Merlin 35

Dimensions:
(T. Mk. 1) Span 40 ft. 0 in. Length 36 ft. 6 in.
Height 11 ft. 11 in. Wing area 270 sq. ft.
(T. Mk. 2) Span 40 ft. 0 in. Length 37 ft. 3½ in.
Height 12 ft. 11 in. Wing area 270 sq. ft.

Weights:
(T. Mk. 1 Mamba) Tare weight 5,067 lb.
All-up weight 7,191 lb.
(T. Mk. 2) Tare weight 6,540 lb. All-up weight (dual) 9,043 lb., (gunnery) 9,101 lb., (navigation) 9,189 lb., (bombing) 9,383 lb.
(*G-ALWA*) Tare weight 5,884 lb.
All-up weight 8,210 lb.

Performances:
(T. Mk. 1 Mamba)
Maximum speed 291 m.p.h. at 20,000 ft.
Cruising speed 256 m.p.h. Initial climb 2,640 ft./min.
Ceiling 34,800 ft. Range 620 miles
(T. Mk. 2)
Maximum speed 293 m.p.h. at 20,000 ft.
Cruising speed 223 m.p.h. Initial climb 2,050 ft./min.
Ceiling 29,000 ft. Range 550 miles

Production:

(*a*) **Athena T. Mk. 1**

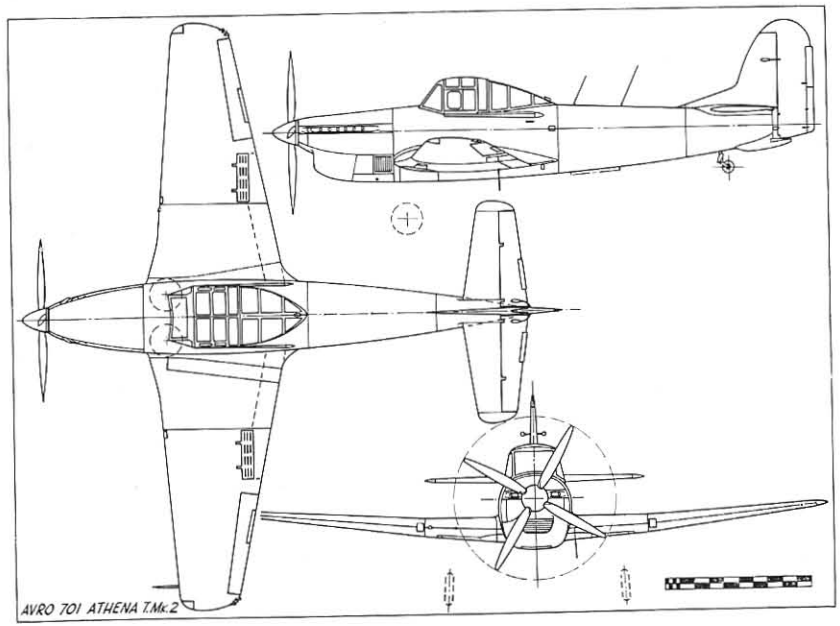
Three aircraft to Specification T.7/45: *VM125* (Mamba) first flown at Woodford 12.6.48, shown at 1948 S.B.A.C. Show; *VM129* (Dart) first flown 17.9.49, shown at 1949 S.B.A.C. Show; *VM132* (Mamba) first flown 12.12.49

(*b*) **Athena T. Mk. 2 prototypes**

Four aircraft to Specification 14/47: *VW890* first flown 1.8.48, to Boscombe Down; *VW891* tail modifications and tropical trials; *VW892* shown at 1949 S.B.A.C. Show thence to Boscombe Down; *VW893* to Empire Test Pilots' School, Farnborough

(*c*) **Athena T. Mk. 2 production**

Fifteen aircraft: *VR566–VR580*. (*VR569* temporarily civil as *G-ALWA*, c/n 1519, C. of A. issued 2.2.50, reverted to *VR569* for S.B.A.C. Show 9.50 after Indian sales tour.)





The Avro 706 Ashton Mk. 1 *WB490*. (*Avro Photo.*)

Avro 706 Ashton

Flight trials of the Tudor 8 with paired Rolls-Royce Nenes in single nacelles showed the need for a tricycle undercarriage to keep the jets clear of the ground when taxying. Designs were therefore put in hand for a Tudor 9 transport, based on the Tudor 2, but equipped with four turbojets and nose wheel undercarriage. This type did not see the light of day, but the Ministry of Supply placed an order for six somewhat similar research aircraft with tall, angular fins and rudders and powered by four 5,000 lb. s.t. Nene 5s and 6s. Known as Avro 706 Ashtons, they utilised Tudor 2 airframes but were given thicker skins and were shortened to Tudor 1 length due to the amount of knowledge accumulated with the Tudor 8 in this configuration. They differed from each other in detail, being intended for a wide variety of experimental flying and comprised one Ashton 1 *WB490*, first flown in September 1950; one Ashton 2 *WB491*; three Ashton 3s *WB492*, *WB493* and *WE670*; and one Ashton 4 *WB494*. The first two had the Tudor 2 pressure cabin with rear pressure bulkhead aft of the entrance door but on the remainder this was moved forward of the door to shorten the pressurised section.

The six Ashton aircraft and their contributions to the advancement of aeronautical knowledge are listed below.

WB490 Ashton Mk. 1, first flown 1.9.50; demonstrated at the 1950 Farnborough S.B.A.C. Show by J. H. Orrell; to the A. and A.E.E., Boscombe Down 1954 for high altitude turbojet research; long range tanks fitted under the outer wings and special autopilot installed; still flying 12.56, dismantled at Woodford and the fuselage used for internal pressure tests.

WB491 Ashton Mk. 2, first flown 2.8.51, flown at the 1951 Farnborough S.B.A.C. Show by J. H. Orrell and J. Nelson; to the R.A.E., Farnborough, for pressurisation, refrigeration, humidification and temperature control investigation. Converted at Luton by D. Napier and Son Ltd. 1954 as a universal engine test bed for the National Gas Turbine Establishment; flown with a Rolls-Royce Avon in a ventral pod. In 1955 the pod was replaced by the 17,500 lb. s.t. Rolls-Royce Conway R.Co.12 Mk. 508 nacelle (with icing rig) for the Boeing 707–420, first flown at Luton by a Napier pilot and also at that year's S.B.A.C. Show; flown 1956 with Armstrong Siddeley Sapphire nacelle with icing rig.

WB492 Ashton Mk. 3, first flown 6.7.51, to the Radar Research Establishment, Defford, for radar bombing research with large under-wing bomb containers and advanced radar bomb sight in a ventral radome.

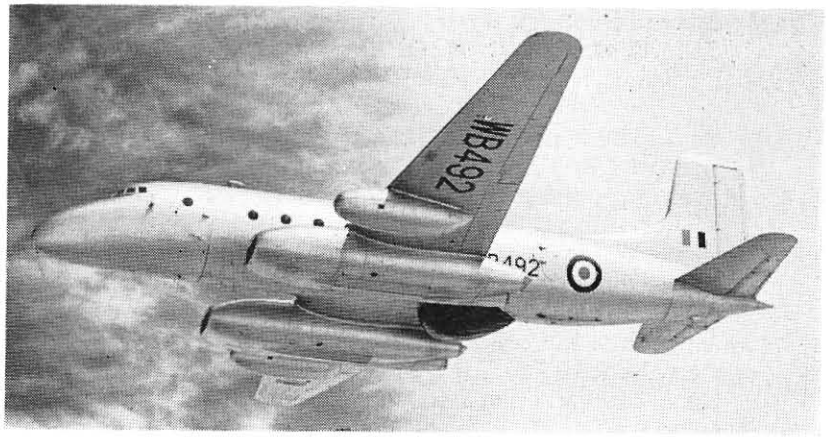
WB493 Ashton Mk. 3, first flown 18.12.51, to the R.A.E., Farnborough, for high altitude brush wear investigations and instrument development. To the Bristol Engine Division, Filton, in 1955 as test bed for advanced marks of reheat Bristol Olympus turbojets. An Olympus was mounted outboard of each nacelle and in 1957–58 the aircraft flew with the port Olympus replaced by the Bristol Orpheus.

WB494 Ashton Mk. 4, first flown 18.11.52, fitted with pressurised ventral bomb aimer's pannier and under-wing bomb containers at the R.A.E. Farnborough 1954–55 for visual bombing research; Sapphire de-icing trials 4.58–2.59.

WE670 Ashton Mk. 3, first flown 9.4.52, used by the Orfordness branch of the R.A.E. for bomb ballistics research; modified by Napier at Luton 1955 and flown at Wymeswold and Hucknall with one Rolls-Royce Avon R.A.14 under the belly with water spray gear for intake icing trials.



The Olympus Ashton Mk. 3 *WB493* landing at Filton, 1955. (*Bristol Photo.*)



Ashton Mk. 3 *WB492* of the Radar Research Establishment, Defford, with wing mounted bomb containers and ventral radar bomb sight. (*Avro Photo.*)



Ashton Mk. 3 *WE670* equipped for icing tests with podded Rolls-Royce Avon. (*Rolls-Royce Photo.*)

SPECIFICATION AND DATA

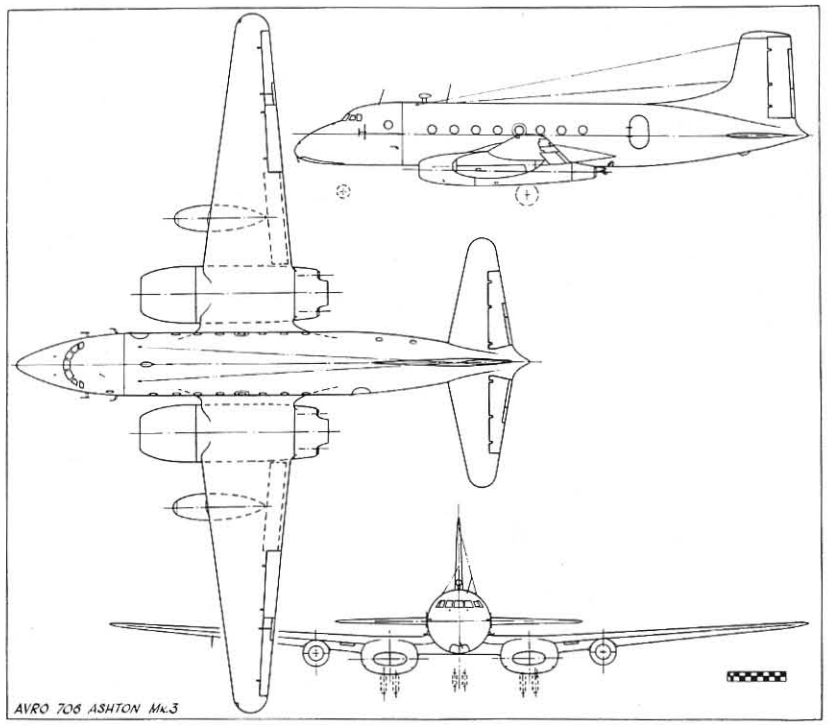
Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire

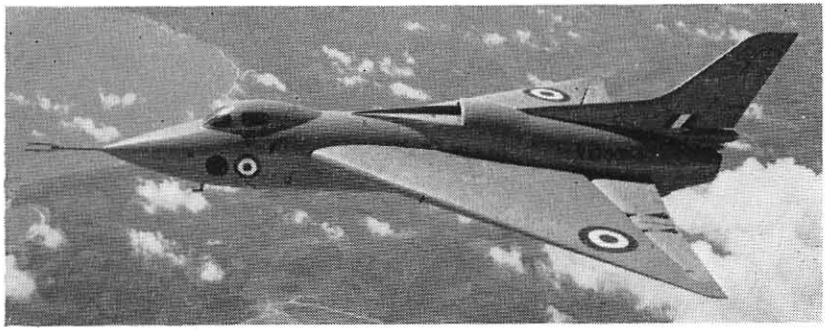
Power Plants: Four 5,000 lb. s.t. Rolls-Royce Nene 5 and 6

Dimensions: Span 120 ft. 0 in. Length 89 ft. 6½ in.
Height 31 ft. 3 in. Wing area 1,421 sq. ft.

Weights: (Mk. 1) All-up weight 72,000 lb.

Performance: (Mk. 1) Maximum speed 439 m.p.h.
Cruising speed 406 m.p.h.





The low speed model Avro 707B *VX790* which retained the dorsal air intake. (*Hawker Siddeley Photo.*)

Avro 707

The Avro 707 was a small delta wing research monoplane powered by a single Rolls-Royce Derwent turbojet, built in 1949 to provide data for the Avro 698 Vulcan. It was a single seater of all-metal, stressed skin construction with sharply tapering mainplane and a dorsal engine air intake faired into a swept fin. Control was by normal rudder combined with four control surfaces hinged to the trailing edge of the wing, the inboard pair acting as elevators and the outers as ailerons. Retractable air brakes were provided above and below the wing, and the cockpit canopy was from a Gloster Meteor.

In R.A.F. marks *VX784*, the Avro 707 was first flown at Boscombe Down on September 4, 1949 by Avro test pilot S. E. 'Red' Esler who spent the next day putting in sufficient flying for the 707 to qualify for inclusion in that year's S.B.A.C. Show. He flew it to Farnborough for static exhibition on September 6 but during a test flight on September 30, crashed near Blackbushe and was killed.

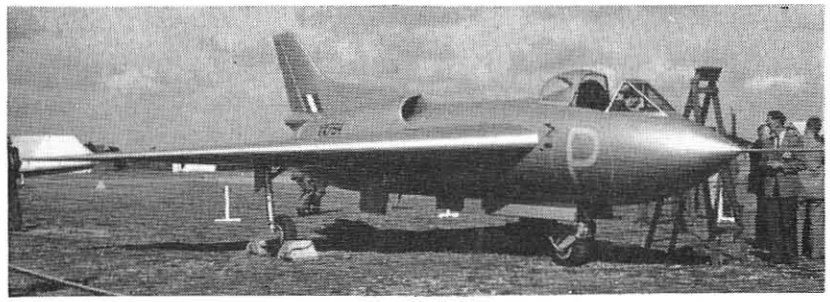
A second aircraft, Avro 707B *VX790*, intended for research into the low speed stability characteristics of delta wings, was first flown on September 6, 1950 by Avro chief test pilot R. J. Falk, who then flew it at the S.B.A.C. Show. Basically similar to the ill fated Avro 707, the 707B was also Derwent powered but incorporated a wing having 51 degrees of leading edge sweepback. To speed construction it used an Avro Athena main undercarriage and a Hawker P.1052 nose wheel leg lengthened by 9 in. to give sufficient take-off incidence. It proved an outstandingly docile aeroplane which completed 100 hrs. of research flying at Dunsfold before going in September 1951 to Boscombe Down where it was flown by Air Marshal J. N. Boothman and subsequently cleared for flying by selected civilian and Service pilots. J. H. Orrell demonstrated the 707B at the 1952 S.B.A.C. Show and a year later it formed an exhibit at the Hatfield R.Ae.S. Garden Party.

High speed data was obtained with a third delta aircraft *WD280*, designated Avro 707A and first flown at Boscombe Down by R. J. Falk on June 14, 1951. It was designed for operation at the highest possible subsonic speed because speeds greater than that of sound required excessive engine power as well as power operated controls.

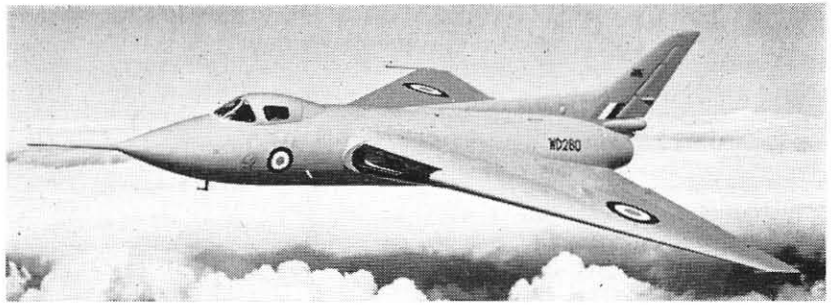
Although nominally a 'low speed' aircraft, the Avro 707B had been flown fast enough for the canopy to set up turbulence around the dorsal air intake and to cause partial starvation of the engine. The 707A was consequently built with wing root intakes, making it virtually a one-third scale model of the Vulcan, with which it flew in patriotic formation at the 1952 S.B.A.C. Show. (See page 409.)

To speed the research programme a second Avro 707A *WZ736* was built (maiden flight February 20, 1953) and the series was completed by a fifth aeroplane *WZ744*, first flown on July 1, 1953. Designated Avro 707C it was a development of the 707A seating two pilots side by side in a widened cockpit for familiarisation purposes, and flew in formation with its three single seat brethren at the 1953 S.B.A.C. Show.

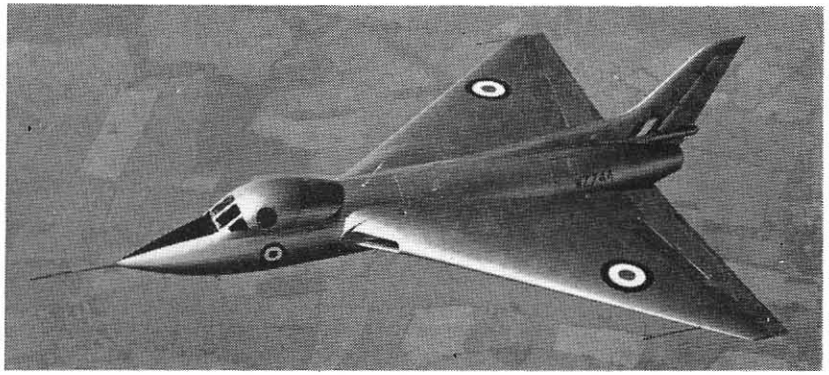
Avro 707A *WD280* flew at the 1953 Paris Aero Show and was later used as test vehicle for the compound sweepback modification subsequently built into the leading edge on all Vulcans. It was afterwards shipped to Australia for investigations into airflow over delta wings at low speed by the Aeronautical Research Laboratories of the Department of Supply and flown from a base at Avalon, Victoria. With serial number repositioned on the nose, it was suspended from the laboratory roof for public exhibition at Avalon in February 1961 and gave a spirited flying display at the Laverton R.A.A.F. base on September 16, 1962. The two seat Avro 707C was transferred to R.A.E., Bedford, for supersonic tests in 1958 and flew with an electric servo system duplicating the normal control circuits. Veteran of more than a decade of experimentation, this machine was still on the strength of the R.A.E., Farnborough, in 1963.



Avro 707 prototype *VX784* at Farnborough, September 1949, showing the Gloster Meteor cockpit canopy. (*Photo courtesy of the Royal Aeronautical Society.*)



The high speed model Avro 707A *WD280*, first of the delta experimentals to feature wing root air intakes. (*Avro Photo.*)



The two seat Avro 707C *WZ744*. (*Avro Photo.*)

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire

Power Plant: One 3,500 lb. s.t. Rolls-Royce Derwent

Dimensions, Weights and Performances:

	Avro 707	Avro 707A	Avro 707B	Avro 707C
Span	33 ft. 0 in.	34 ft. 2 in.	33 ft. 0 in.	34 ft. 2 in.
Length	30 ft. 6 in.	42 ft. 4 in.	42 ft. 4 in.	42 ft. 4 in.
Height	—	11 ft. 7 in.	11 ft. 9 in.	11 ft. 7 in.
All-up weight	—	—	9,500 lb.	10,000 lb.

Production:

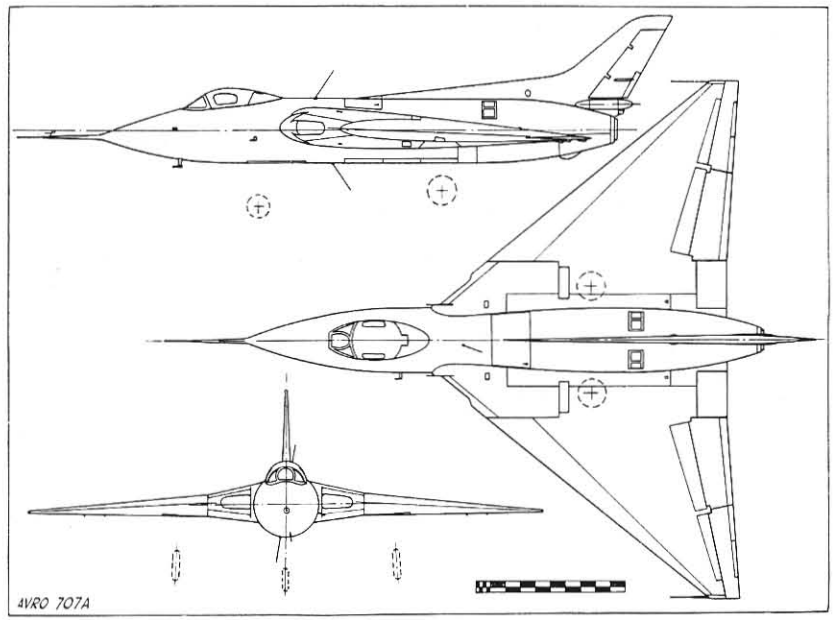
Avro 707, *VX784*, first flown at Boscombe Down 4.9.49, crashed near Blackbushe 30.9.49

Avro 707B, *VX790*, low speed model, first flown at Boscombe Down 6.9.50

Avro 707A, *WD280*, first high speed model, flown 7.51; to the Australian Department of Supply for boundary layer tests 1958

Avro 707A, *WZ736*, second high speed model, first flown 20.5.53

Avro 707C, *WZ744*, two seat familiarisation aircraft, first flown 1.7.53





C-91.2500, first of six Avro 748 Series 2 transports built for the Brazilian Air Force. (*Avro Photo.*)

Avro 748

Following a company decision to re-enter the civil market after many years of military production, an Avro project design team under J. R. Ewans explored a number of layouts for a short/medium range feeder liner. In 1958 the first project to bear type number Avro 748 appeared as a twin 1,000 h.p. turboprop 20 seater with a span of 75 ft. and operating at a maximum gross weight of 18,000 lb. Low and high wing versions were considered but market research revealed insufficient interest in an aircraft of this size and the project was scaled up into the Dakota replacement class. This also permitted the use of Rolls-Royce Dart engines of proven reliability.

In January 1959 the Hawker Siddeley Group decided to build the Avro 748 in this form as a private venture and a month later the Chadderton Works commenced construction of four prototypes, two for static tests and two for flight trials. Work proceeded rapidly and the first flying prototype *G-APZV* was flown at Woodford for the first time by chief test pilot J. G. Harrison only 18 months later on June 24, 1960.

An all-metal, low wing, pressurised monoplane of orthodox appearance and Avro fail-safe construction with circular section fuselage, it accommodated up to 44 passengers in four abreast seating with central gangway. The outer panels of the two-spar mainplane were attached to a centre section built integral with the fuselage, and to give adequate ground clearance to large diameter airscrews and avoid cut-outs in the spars, the Dart engines were mounted high up in close fitting cowlings with the jet pipes passing over the wing. The forward retracting, twin wheel undercarriage was housed in a bulbous compartment ahead of the leading edge, creating the now familiar Avro 748 cranked engine nacelle.

To support its claim to be a Dakota replacement, the Avro 748 was designed for a balanced field length of 3,400 ft., obtained by the use of large diameter airscrews, powerful brakes, electrically operated Fowler flaps of special design, and large fin and rudder. Reliability resulted from the use of the 1,740 h.p. Dart 514 power plant and Rotol gearbox of the Vickers Viscount 800, the A. W. Argosy's 12 ft. four bladed reversing airscrews, and Vickers Vanguard pressurisation equipment.

Before the first aircraft had been completed, Skyways Coach-Air Ltd. and B.K.S. Air Transport Ltd. ordered three and two Avro 748s respectively. The Indian Government also acquired a licence to build the slightly heavier Avro 748M (later known as Avro 757) with strengthened floor for military use, and established a works at the Indian Air Force base at Kanpur, where six Manchester-built aircraft were erected as a prelude to purely local construction. The first Avro 748M was flown on November 1, 1961 and christened "Subroto" after a former Indian Chief of Air Staff.

Carrying full instrumentation and water tanks which enabled the C.G. to be changed from the aft to forward limit in three minutes, the first prototype completed 60 hrs. flying by its 20th flight. Five weeks on the ground for modification and maintenance were followed by an appearance at the Farnborough S.B.A.C. Show on September 5, 1960 and the issue of a C. of A. next day. The completion of the third airframe as the second flying prototype *G-ARAY*, flown at Woodford by J. G. Harrison on April 10, 1961, considerably speeded the test programme. This partly furnished aircraft had the forward freight door on the port instead of starboard side. Performance trials with this aircraft at Nicosia and Madrid in July 1961 were followed by the installation of the more powerful Dart R.Da.7 engines to permit operation from aerodromes of up to 8,500 ft. altitude. Thus powered it became the prototype Avro 748 Series 2 and first flew on November 6, 1961. It was named "City of Perth" on March 7, 1962 and next day left for tropical trials at Nairobi, Kenya and Kano, Nigeria.

Destined for Skyways Coach-Air Ltd., *G-ARMV*, the first production Series 1, made its initial flight at Woodford on August 31, 1961 and appeared at the Farnborough S.B.A.C. Show a few days later. A 12,600 mile demonstration tour to visit the Kanpur production line and to publicise the aircraft in Australia preceded the handing over to Skyways for 160 hours of route proving between Lympne, Beauvais, Lyon and Montpellier. Satisfactory static tests with the second and fourth airframes then led to the issue of a full British C. of A. on December 7, 1961 and to the clearance of the Series 1 at an increased all-up weight of 36,800 lb. and the Series 2 (with structural strengthening) at 42,000 lb., permitting them to operate as 48 and 52 seaters respectively. The maximum take-off weight of the Series 2 was further increased to 43,500 lb. in September 1963.

Fatigue tests having shown the wing to be slightly over-strength, production aircraft were built with a 3 ft. 6 in. increase in span. *LV-PIZ*, second production aircraft and first of nine ordered by Aerolineas Argentinas in



The prototype Hawker Siddeley 748MF *G-ARRV* flying with the rear doors and ramp open as the aircraft appears in the supply dropping role. (*Hawker Siddeley Photo.*)

March 1960, first flew on December 10, 1961 and was delivered to the Argentine by Avro test pilot Colin Allen. The 11,300 mile flight via Stornoway and the North Atlantic route was completed in 8 days and *LV-PIZ* arrived at Ezeiza Airport, Buenos Aires, on January 26, 1962. The co-pilot was Capt. Arturo Micelli who ferried all subsequent Argentine 748s. At a ceremony in the following month the Bishop of Lomas christened the first machine "Ciudad de Bahia Blanca", the rest of the fleet also receiving names of the cities they would serve. All were given permanent registrations on arrival and three additional Avro 748s were ordered in 1963.

Quick to exploit this most promising design, the Avro project department produced layouts for several specialised variants, the chief of which were:

Avro 748E A stretched Series 2 with 6 ft. fuselage extension to operate at an all-up weight of 43,000 lb. and carry up to 60 passengers.

Avro 748 Super E High performance variant of the above powered by two 2,400 h.p. Rolls-Royce Dart R.Da.10s

Avro 748F A civil freight version of the Series 1 with freight door and the strengthened floor of the Avro 748M

Avro 757 Military freight version of the Series 1 built under licence by the Indian Air Force and known publicly as the Avro 748M

Avro 758 Layout made for the Indian Air Force for a high wing assault version of the Avro 757 with a 2 ft. increase in fuselage diameter, swing-tail rear loading, underslung nacelles, and undercarriage retracting into the fuselage. Span 97 ft. 4 in. All-up weight 43,600 lb., Cruise 230 knots at 20,000 ft.

Avro 778 A version with two aft-mounted 7,000 lb. s.t. Bristol B.S.75 turbo-fan engines using the Avro 748E main structure but with reduced span for high speed. All-up weight 50,000 lb.

The Series 2 prototype completed high altitude trials in India but a resultant order for three aircraft (intended as *VR-AAU-'AW*) placed by Aden Airways Ltd. in April 1960 was cancelled in May 1962 and the machines absorbed into an order for six for the Brazilian Air Force special Transport Group. These were all ferried by the North Atlantic route for use mainly on a shuttle service between Brasilia and Rio de Janeiro.

Skyways Coach-Air Ltd. introduced its first Series 1 *G-ARMV* into service on the Lympne–Beauvais ferry on April 1, 1962 but leased its second machine *G-ARMW* (delivered in the following month) to B.K.S. Air Transport Ltd. pending delivery of its own Avro 748s. *G-ARMW* inaugurated the B.K.S. Yeadon–London service on October 1, 1962, cut flying time by one third and produced a 49% increase in traffic. This machine served Belfast from March 6, 1963 and was joined by the first B.K.S. owned aircraft *G-ARRW* on April 27. On October 28, 1963 Avro 748 Series 1 *G-ASJT* was delivered to Smith's Aviation Division, Staverton, for autopilot development.

The excellent performance put up by the Series 2 prototype *G-ARAY* during tests from unprepared surfaces, including deeply rutted mud, at Martlesham in February 1962, made an R.A.F. order for the Avro 748MF certain in the face of competition from the Handley Page Dart Herald. Six Avro 748 Series 2 were also ordered for R.A.F. Transport Command, two to be operated by the Queen's Flight. Type name Avro Andover, first used by the Avro 561 in 1924, was allotted to all R.A.F. Avro 748s, irrespective of type, in April 1964.

An unobstructed cabin with 6 ft. 3½ in. headroom permitted several luxurious interior layouts, one of which was built into *G-ARAY* early in 1963 for the use of Hawker Siddeley executives. It then left on a 40,000 mile world tour as a result of which one was supplied to the King of Thailand and three commercial models to Thai Airways. The Indian Airlines Corporation also announced its intention of acquiring a number of Kanpur-built 748 Series 2 aircraft, the first of which, *BH576*, first flew on January 28, 1964. It was later evaluated by the Corporation on freight services in Assam.

Demonstrator *G-ARAY* again left Woodford on December 31, 1963 for an extensive tour via Greenland and the Caribbean to South America. After calling at Vancouver it returned to base on March 10, 1964. Including the tour of Africa and the Far East in April–May 1963, *G-ARAY* had flown 91,263 miles in 413½ hours.

While the majority of variants remained only projects, a heavier and more powerful version with upswept tail and rear loading door, announced as the Avro 748MF (Military Freighter), but known internally as the Avro 780, was ordered in quantity for the R.A.F. in March 1962. Powered by two Dart R.Da.12s driving 14 ft. 6 in. Dowty-Rotol airscrews, the R.A.F. version was equipped with a widened centre section which increased the span by 3 ft., larger wheels, and a reinforced floor for carrying wheeled vehicles. So that the rear ramp could be brought on a level with the tail boards of freight lorries, undercarriage height could be varied hydraulically. Alternative internal lay-

outs in the STOL support role were for 40 paratroops, 48 fully equipped troops, or casualty evacuation for 15 sitting and 18 stretcher cases. To speed completion of the first Avro 748MF, the first prototype Series 1 *G-APZV* returned to the Engineering Development Department at Chadderton for conversion on August 2, 1962. Piloted by J. G. Harrison, it was airborne from Woodford for 2 hrs. 5 min. on December 21, 1963 in the course of its maiden flight as the Avro 748MF prototype *G-ARRV*.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Greengate, Middleton, Manchester; and Woodford Aerodrome, Cheshire; restyled the Avro-Whitworth Division of Hawker Siddeley Aviation w.e.f. July 1, 1963
The Indian Air Force Maintenance Base, Kanpur, India

Power Plants:
(Avro 748 Ser. 1) Two 1,740 h.p. Rolls-Royce Dart 514 (R.Da.6)
(Avro 748 Ser. 2) Two 1,910 h.p. Rolls-Royce Dart 531 (R.Da.7)
(Avro 748M) Two 1,740 h.p. Rolls-Royce Dart R.Da.6
(Avro 748MF) Two 3,000 h.p. Rolls-Royce Dart R.Da.12

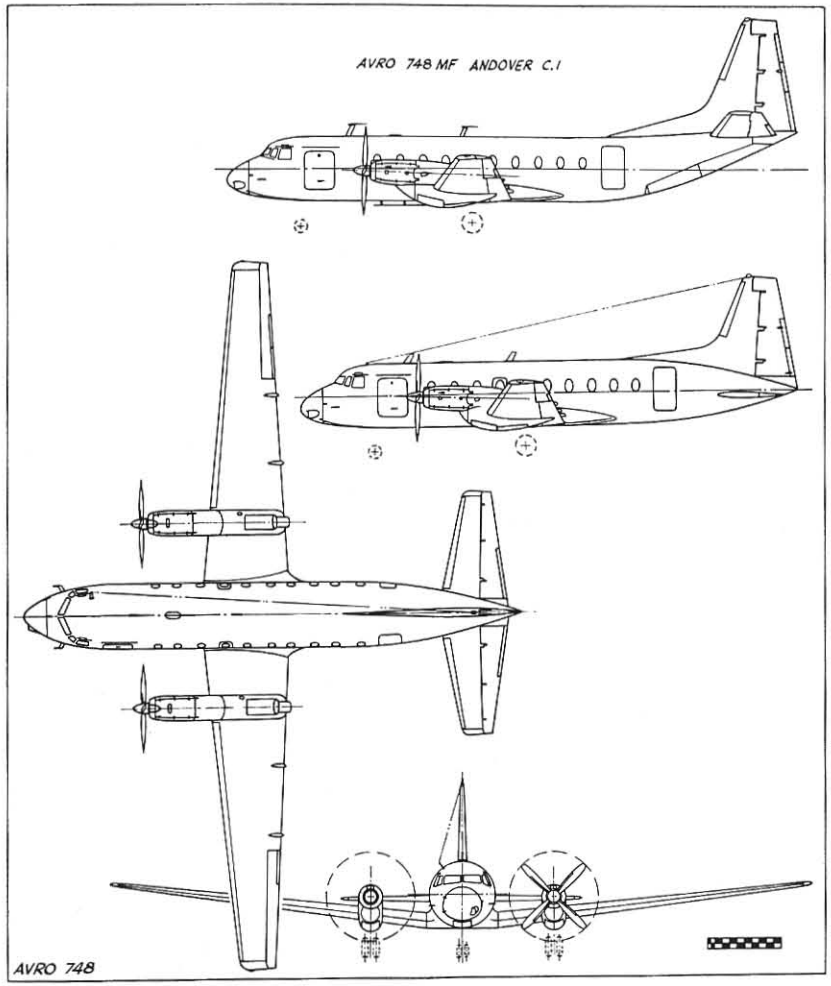
Dimensions, Weights and Performances:

	Prototypes	Series 1	Series 2	Avro 748MF
Span	95 ft. 0 in.	98 ft. 6 in.	98 ft. 6 in.	98 ft. 0 in.
Length	67 ft. 0 in.	67 ft. 0 in.	67 ft. 0 in.	78 ft. 0 in.
Height	24 ft 10½ in.	24 ft 10½ in.	24 ft 10½ in.	29 ft 0 in.
Wing area	795 sq. ft.	811 sq. ft.	811 sq. ft.	831 sq. ft.
Tare weight	19,444 lb.	22,614 lb.	24,296 lb.	27,191 lb.
All-up weight	33,000 lb.	38,000 lb.	43,500 lb.	50,000 lb.
Maximum speed	230 knots	—	317 knots	235 knots
Range	1,630 n.m.	1,565 n.m.	1,695 n.m.	—

Production:

(*a*) **Prototypes**

1. *G-APZV*, c/n 1534, first flown 24.6.60, Special Category C. of A. 6.9.60, to Chadderton works 2.8.62 for prototype Avro 748MF conversion. Re-registered *G-ARRV* with new c/n 1548
2. Unregistered, static test airframe, pressurisation tests in A.W. rig 12.59; full pressure tests in water tank, Woodford 2.60; later tested to destruction
3. *G-ARAY*, c/n 1535, Chadderton–Woodford for assembly 5.3.61, first flown 10.4.61, Special Category C. of A. 29.5.61, first flown as Series 2 prototype 6.11.61, Hawker Siddeley executive aircraft 1963
4. Unregistered, static test airframe, fatigue test at Chadderton 7.61 when 48,000 cycles (equivalent to 72,000 hrs. flying) were completed before failure



(*b*) **Avro 748 Series 1**

For Skyways Coach-Air Ltd.: c/n 1536–1538, *G-ARMV–'MX*; first flown 31.8.61, 8.5.62 and 19.10.62; Cs. of A. issued 30.3.62, 28.5.62 and 9.4.63 respectively.

For Aerolineas Argentinas: c/n 1539–1547, *LV-PIZ/LV-HGW* "Ciudad de Bahia Blanca" first flown 10.12.61/C. of A. issued 9.1.62; *LV-PJA/LV-HHB* "Corrientes" 20.2.62/6.3.62; *LV-PRJ/LV-HHC* "Concordia" 2.4.62/13.4.62; *LV-PUC/LV-HHD* "Salta" 21.4.62/31.4.62; *LV-PUF/LV-HHE* "Resistencia" 19.5.62/29.5.62; *LV-PUM/LV-HHF* "San Juan" 9.6.62/20.6.62; *LV-PUP/LV-HHG* "Mar del Plata" 29.6.62/6.7.62; *LV-PVH/LV-HHH* "Neuquen" 14.7.62/27.7.62, damaged in forced landing 4.9.62 when the rudder

struck the cabin door during investigations into accidental door-opening in flight; *LV-PVI/LV-HHI* "Rio Gallegos" 20.7.62/30.7.62; c/n 1556–1558, *LV-PXD/LV-IDV* 19.7.63/13.8.63; *LV-PXH/LV-IEE* 6.9.63/30.9.63; *LV-PXP/LV-IEV* 24.10.63/15.11.63

For other operators: c/n 1549, *G-ARRW*, first flown 10.12.61/C. of A. issued 18.4.63, B.K.S. Air Transport Ltd.; c/n 1559, *G-ASJT*,* S. Smith and Sons (England) Ltd. 24.10.63/15.11.63; c/n 1560 *G-ASPL*, —.—.64/—.—.64 B.K.S. Air Transport Ltd.

(*c*) **Avro 748 Series 2**

Prototype *G-ARAY* c/n 1535; six for the Brazilian Air Force, c/n 1550–1555, serial *C-91.2500**, first flown 27.8.62/delivered 17.11.62; *C-91.*2501* 16.1.63/26.2.63; *C-91.2502* 22.2.63/20.3.63; *C-91.2503* 19.3.63/19.4.63; *C-91.2504** 10.6.63/4.7.63; *C-91.2505* 30.8.63/28.9.63; two Andover CC.Mk.2, c/n 1561–1562, *XS789* and *XS790* for the Queen's Flight; four Andover C.Mk.1, c/n 1563–1566, *XS791–XS794* for R.A.F. Transport Command; three for Thai Airways, c/n 1567–1569, *HS-THA* first flown 25.8.64, '*HB* rolled out 12.11.64, and' *HC*; one for the Royal Thai Air Force, c/n 1570; one for Air Ceylon, c/n 1571, *4R-ACJ*, delivered 27.10.64.

*Erected at Hawarden Aerodrome, Chester.

(*d*) **Avro 748s built in India**

Commenced with six aircraft erected from Manchester-built components: (Series 1) *BH572* "Subroto" first flown 1.11.61; *BH573* "Jumbo" first flown 13.3.63. (Series 2) *BH576* first flown 28.1.64.

(*e*) **Hawker Siddeley 748MF Andover**

One prototype *G-ARRV*, c/n 1548, first flown 21.12.63, C. of A. issued 4.9.64; followed by a substantial production order.

APPENDIX A

CONSTRUCTION FOR OTHER MANUFACTURERS

Success came to the autogiro purely as a result of long years of joint experiment by A. V. Roe and Co. Ltd. and the Cierva Autogiro Co. Ltd., in the course of which standard Avro biplanes of several types were shorn of mainplanes and equipped with rotors. Experiment gave place to limited production of the Cierva C.19 by A. V. Roe and Co. Ltd. at Hamble in 1929 as the Avro 620; and later to the construction of the Cierva C.30A in some numbers under licence at Manchester as the Avro 671. These were not related to any Avro type and do not qualify for inclusion in the main part of this book.

The only other non-Avro aircraft to be honoured with type numbers were the Parnall Monoplane for which the company built the Avro 661 experimental mainplane in 1934; and the Egyptian Army Air Force Audax aircraft which went through the works in 1937–38 as Avro 674s.

In addition to the above, the company also built 287 Hawker Audax biplanes 1935–37; 1,000 Bristol Blenheims and the single production Hawker Tornado *R7936* during the Second World War; as well as 75 English Electric Canberras postwar.



(P. T. Capon Photo.)

AVRO 620 (CIERVA C.19)

Close collaboration between Señor Juan de la Cierva, designer of the rotor systems, and A. V. Roe and Co. Ltd. who built the airframes, led to such phenomenal progress in autogiro development that three more C.17 Mk. IIs laid down in 1929 were completed as an entirely new type. This was the corpulent little C.19 which owed nothing to any previous Avro design. Thus the three Cierva C.19 Mk. I (80 h.p. Armstrong Siddeley Genet II), three Mk. II (105 h.p. Genet Major 1), one Mk. IIA (improved rotor head), six Mk. III (monoplane tail), fifteen Mk. IVP production models, and one Mk. V experimental cannot be regarded as Avro types. All were built at Hamble under type number Avro 620 and are listed below. A further batch was constructed by Focke Wulf Flugzeugbau GmbH, at Bremen, Germany.

C.19 Mk. IVP: Rotor diameter 34 ft. 0 in. Length 18 ft. 3 in. Tare wt. 1,054 lb. A.U.W. 1,550 lb. Maximum speed 102 m.p.h. Cruise 95 m.p.h. Initial climb 465 ft./min. Ceiling 11,200 ft. Range 250 miles. Rotor speed 180 r.p.m.

Production:

(*a*) Cierva C.19 Mk. I

Constructor's No. and Registration		*C. of A. Issued*	*Details*
5130	*G-AAGK*	2. 8.29	Sold abroad 1.30
5131	*G-AAGL*	30. 8.29	Crashed at Haldon, Teignmouth 21.9.29
5132	*G-AAHM*	22. 3.32	Converted to C.19 Mk. IV, crashed at White City Stadium, London 29.9.32

(*b*) Cierva C.19 Mk. II

5133	*G-AAKY*	nil	Sold in the U.S.A. to H. Pitcairn 12.29, believed as *NC311V*
5134	*G-AAKZ*	26. 9.29	Crashed at Sherburn-in-Elmet 21.5.31
5135	*G-AALA*	24.12.29	Converted to C.19 Mk. III, crashed 5.32
5136	*G-AAUA*	1. 8.30	C.19 Mk. IIA, sold abroad 3.31

(*c*) Cierva C.19 Mk. III

5137	*G-AAYN*	nil	Sold abroad 10.30
5138	*G-AAYO*	10. 9.30	On R.A.F. charge 6.11.30 as *K1696*, s.o.c. 21.2.31
5139	*G-AAYP*	10. 9.30	To C.19 Mk. IV, scrapped 1932
5140	*G-ABCK*	14.10.30	To New Zealand 12.30 as *ZK-ACL*, crashed Oamaru 5.31, wreck shipped to the U.K.
5141	*G-ABCL*	20.10.30	Crashed 29.11.30
5142	*G-ABCM*	13.12.30	Delivered Hamble–Farnborough 5.1.31, on R.A.F. charge 16.1.31 as *K1948*, s.o.c. 14.3.34

(*d*) Cierva C.19 Mk. IV

Constructor's Numbers	Aircraft markings
5143–5145	*G-ABFZ, 'GB, 'GA*
5148–5153	*G-ABUC/VR-SAR, 'UD, 'UE, 'UF, 'UG/SE-ADU, 'UH/VH-USO*
5154–5159	*G-ABXD, 'XE, 'XF/J-BAYA, 'XG, 'XH/EC-W13/EC-ATT, 'XI*/Spanish Air Force *49-1*

Note: The single Cierva C.19 Mk. V *G-ABXP* had neither constructor's number nor C. of A. and was scrapped in 1935



(Crown Copyright Reserved.)

AVRO 661

Two parasol monoplanes *K1228* and *K1229* (one 200 h.p. Armstrong Siddeley Lynx IV), were designed and built by George Parnall and Co. at Yate, Glos. and delivered to Farnborough on August 20 and October 15, 1930 respectively for full scale tests on wing sections by the Aerodynamics Dept. of the R.A.E. Parnalls also supplied a series of 42 ft. span wings, all of rectangular planform and aspect ratio 6, but of varying section, which could be mounted on a 'floating' rig of steel struts to enable lift and drag to be measured with a dynamometer.

In 1934 it was decided to test the new Zap split flaps, the hinges of which moved along rails as the flap was lowered. A wing of R.A.F. 28 section equipped with this flap system and ordered from A. V. Roe and Co. Ltd. to Air Ministry Specification 15/34 under type number Avro 661, was built to designs supplied by the Zap Development Corporation, and *K1229* was sent to Woodford for it to be fitted. Apart from a gap in the centre, the flap extended over the whole span, and 'park bench' ailerons were mounted above it.

K1229 was weighed at Woodford on completion on December 1, 1934 and returned to Farnborough on January 28, 1935 in company with Cierva C.30A (Avro 671) *K4775*. Tests ran from February 22 to August 14 when the Avro wing was replaced by the standard Göttingen 387 test wing. The aircraft did not fly again after F/O A. E. Clouston forced landed at Sutton Green on March 31, 1936.

Span 32 ft. 0 in. Length 28 ft. 0 in. Wing area 294 sq. ft. All-up weight (Avro 661 wing) 3,070 lb.



('Flight' Photo 14516.)

AVRO 671 (CIERVA C.30A)

Early in 1934 A. V. Roe and Co. Ltd. acquired a licence to build the Cierva C.30A two seat autogiro (140 h.p. Armstrong Siddeley Genet Major IA), including the whole of the rotor system, at Manchester. Developed from the C.19 Mk. V via the C.30 *G-ACFI* (erected at Hanworth by National Flying Services Ltd. from an Avro-built C.19 fuselage), the C.30P prototype *G-ACKA* (built entirely by Airwork Ltd., Heston), and three pre-production C.30Ps *G-ACIM-'IO* (built by Avro at Manchester), the C.30A featured folding rotor blades and reverse aerofoil section on the port tailplane to counteract rotor torque.

Ordered by the Air Ministry for Army Co-operation evaluation in 1934, the C.30A was allotted airframe and engine Service names Rota I and Civet I. Specification 16/35 was written round the Rota I in 1935 at a time when it was belatedly given type number Avro 671.

Civil and export production amounted to 66 aircraft, built at Manchester and distributed via the Cierva base at Hanworth. Construction also took place in France where 25 were built by Lioré et Olivier as the Le.O. C.301 (175 h.p. Salmson 9NE) and in Germany where Focke Wulf built 40 (Siemens engine). Several British civil C.30As, impressed 1939–41 for coastal radar calibration, survived the War to fly again in civil marks post-1945 and *G-ACWP*/*AP507* remains on permanent exhibition at the Science Museum, London.

Cierva C.30A: Rotor diameter 37 ft. 0 in. Length 19 ft. 8½ in. Tare wt. 1,220 lb. A.U.W. 1,800 lb. Maximum speed 110 m.p.h. Cruise 95 m.p.h. Initial climb 700 ft./min. Range 285 miles. Rotor speed 180 r.p.m.

Production:

(*a*) **Avro 671 Rota I**

Ten (later 12), ordered by the Air Ministry 14.2.34, delivered between 24.8.34 and 23.5.35 to Specification 16/35: *K4230–K4239* and *K4296* (delivered Rochester-Felixstowe on floats 15.4.35) and *K4775*.

(*b*) **Civil and export C.30As**

Constructor's Numbers	Aircraft markings
705–717	*G-ACUI, 'VC, 'VX/PH-ASA, G-ACWF, 'WG/F-AOHY, G-ACWH, 'WI/F-AOIO, G-ACWJ/PH-HHH, G-ACWK/D-EKOM, G-ACWL/D-EKOP, G-ACWM–'WO*
725, 726, 728	*G-ACUT, 'UU, 'WP*
731–745	*G-ACWR, 'WS/G-AHUC/SE-AZA, 'WT/F-AOLK,* China (1), *LN-BAD/SE-AFI, G-ACWU/HB-MAB, G-ACXW, PP-TAF, OK-ATS, SE-AEA, VT-AFF, 'FS, G-ACXG/PH-ARA, G-ACXV, 'YP/SP-ANN*
748–750	*VT-AFQ, G-ADKY,* Danish Army *M.1/SE-AKW*
752–757	*G-ACWZ, 'XA/I-CIER/MM.30030, G-ACXB, 'XC, EA-SCA, 'CB*
760, 771, 772	*G-ACXR, 'YH, 'XP/VH-USQ*
775–777	*G-ACYE, YC/F-AOHZ, LY-LAS*
779–782	Russia (1), *G-ADCK/VH-UUQ,* Spanish *41–2, 41–3*
791, 792, 798	*G-ACZV, VH-USR, G-ADBJ*
800–804	French Air Ministry (5)
808, 815	China (1), *OE-TAX*
818, 985	Belgian Air Force (1), Danish Army *M.2*
1029–1032	Yugoslav Air Force Nos. *1* and *2*, Argentina (2)



(Photo courtesy of J. A. Bagley.)

AVRO 674

To assist in the R.A.F. Expansion Programme 1935–37, A. V. Roe and Co. Ltd. built 287 Hawker Audax army co-operation biplanes (Rolls-Royce Kestrel engines) to Air Ministry Specification 34/34. These were standard aircraft and did not receive an Avro type number. Later, as the result of an Anglo-Egyptian Treaty signed in 1936 which gave the Egyptian Army Air Force and the R.A.F. joint responsibility for the air defence of Egypt, the Sudan and the Canal Zone, the Egyptian Government ordered six modernised Audaxes powered by 750 h.p. Armstrong Siddeley Panther VIA radials. Construction of these special aircraft was also entrusted to A. V. Roe and Co. Ltd. who, in view of the amount of redesign, allotted their own type number Avro 674. Delivery in March 1937 was followed by a second contract for 18 (Panther X), completed between February and May 1938.

SPECIFICATION AND DATA

Manufacturers: A. V. Roe and Co. Ltd., Newton Heath, Manchester

Designers: Hawker Aircraft Ltd., Canbury Park Road, Kingston-on-Thames, Surrey

Power Plant: One 750 h.p. Armstrong Siddeley Panther VIA or X

Dimensions: Span 37 ft. 3 in. Height 10 ft. 5 in.
Wing area 348 sq. ft.

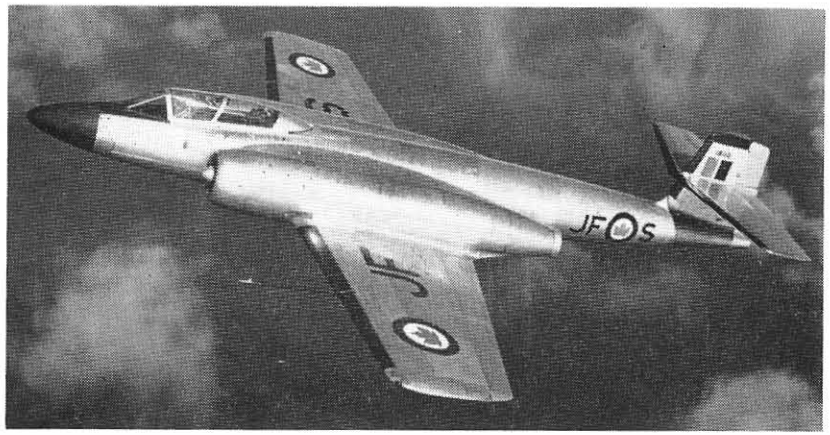
Production: *K400–K405*, c/n 943–948, delivered 3.37 to Avro Works Order 17523; *K501–K518*, c/n 1035–1052, delivered 2.38–5.38 to Avro Works Order 19177

APPENDIX B

AIRCRAFT DESIGNED BY A. V. ROE CANADA LTD.

Formed late in 1945 when A. V. Roe and Co. Ltd. acquired Victory Aircraft Ltd. of Malton, Ontario, which had already built 3,634 Avro aircraft comprising 430 Lancasters, 3,197 Ansons, one York and six Lincolns.

The new firm's first aircraft, the Avro Canada CF-100 Canuck, was the first jet fighter designed in Canada and was designated in the Royal Canadian Air Force C- series as also were the CF-104 delta projects and the CF-105 Arrow. Although not designed to a R.C.A.F. specification, the Avro Jetliner was given a private designation C-102 which fitted neatly into the system.



(Canadian National Defence Photo.)

AVRO CANADA CF-100 CANUCK

All-metal, two seat, twin engined, long range all-weather fighter designed for Arctic defence 1947–48. *18101*, first of two Rolls-Royce Avon powered CF-100 Mk. 1 prototypes, first flown at Malton by W. A. Waterton 19.1.50. First of ten pre-production Mk. 2 (Avro Orenda Mk. 1 turbojets) flew 20.6.51 and one was equipped as a Mk. 2T dual trainer.

First R.C.A.F. production batch of 70 Mk. 3 (Orenda 2s) equipped with tip tanks and armed with eight 0·5 in. guns in a ventral tray, included a number of Mk. 3CT trainers. Main production began with Mk. 4A (Orenda 9s) with longer nose housing the Hughes APG-40 fire control system. Armed solely with 2·75 in. Mighty Mouse rockets, 48 in a ventral pack and 58 in wing tip pods. Prototype flown by Jan Zurakowski 11.10.52, first production flew 24.10.53. Final examples were Mk. 4B (Orenda 11) three of which, *18320–22*, arrived at the C.F.E., West Raynham, Norfolk, for evaluation 27.3.55. *18321–22* were shown at the 1955 Farnborough S.B.A.C. Show.

Production of the Mk. 5, a lightened and more powerful P.R.U. fighter version with increased span for improved high altitude performance, included 53 for the Belgian Air Force (deliveries commenced 12.57). The prototype Mk. 5, *18323*, originally known as the Mk. 4C, flew 9.54 and construction ceased 12.58 at the 692nd aircraft, but a considerable number of Mk. 4Bs were converted to Mk. 5s, and at least two were Mk. 5M with Sparrow missiles.

SPECIFICATION AND DATA

Mk. 4B Two 7,275 lb. s.t. Avro Orenda 11, span 52 ft. 0 in. (53 ft. 7 in. with rocket pods), length 54 ft. 2 in., wing area 540 sq. ft., tare weight 24,408 lb., all-up weight 35,500 lb., maximum speed 650 m.p.h. at 10,000 ft., initial climb 8,000 ft./min.

Mk. 5 Two 7,275 lb. s.t. Avro Orenda 14, span 60 ft. 10 in., length 54 ft. 2 in., wing area 591 sq. ft., tare weight 23,100 lb., all-up weight 36,000 lb., maximum speed 650 m.p.h. at 10,000 ft., initial climb 8,500 ft./min., ceiling 54,000 ft., range 2,000 miles

R.C.A.F. serials: (Mk. 1) *18101–18102*; (Mk. 2) *18103–18112*; (Mk. 3) *18113–18182*; (Mks. 4 and 5) *18183–18792*.

Service Use: By nine R.C.A.F. home defence squadrons including Nos. 419, 423, 425, 428 and 445; and by four squadrons of No. 1 Air Division in Europe; also by the 1st All-Weather Interceptor Wing, Belgian Air Force, Beauvechain



(Avro Canada Photo.)

AVRO C-102 JETLINER

A 50 passenger medium range transport similar to the Avro Tudor 8. Designs commenced in 1946 envisaged the use of two Rolls-Royce Avon turbojets the non-availability of which led, in the autumn of 1947, to the fitting of four 3,600 lb. s.t. Rolls-Royce Derwent 5s.

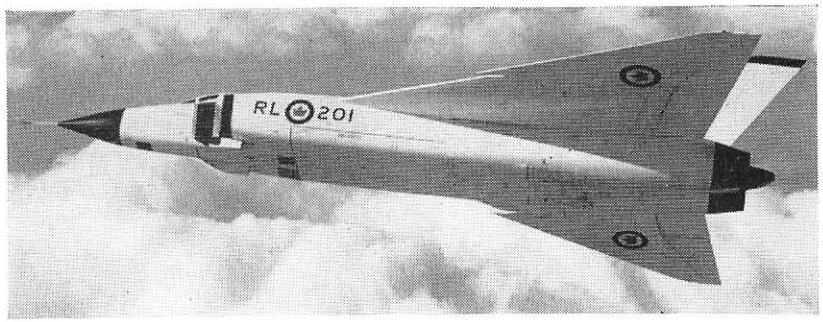
Prototype *CF-EJD-X* first flown at Malton by Avro chief test pilot J. H. Orrell 10.8.49, belly landing at Malton due to undercarriage failure 16.8.49, repaired and completed 10 hrs. flying before public demonstration 5.10.49. Re-engined with Derwent 8s (starboard outer, port inner) and Derwent 9s for Toronto–Ottawa flight 11.4.50 in 36 min. at 418 m.p.h.; and New York mail flight 19.4.50. Flew 150 hours by 12.50, reached 39,800 ft. and exceeded 500 m.p.h. in level flight.

No orders were received and construction of the partially built second prototype was abandoned.

Span 98 ft. 1 in., length 82 ft. 5 in., wing area 1,097 sq. ft., tare weight 27,427 lb., all-up weight 55,000 lb., maximum speed at 30,000 ft. 417 m.p.h., cruising speed at 30,000 ft. 376 m.p.h., initial climb 2,220 ft./min., ceiling 40,300 ft., maximum range 1,680 miles.

AVRO CANADA CF-103

A projected twin engined swept wing fighter announced in May 1952 as a CF-100 replacement for the R.C.A.F. No prototype or production contracts were placed and the CF-103 was not built.



(Avro Canada Photo.)

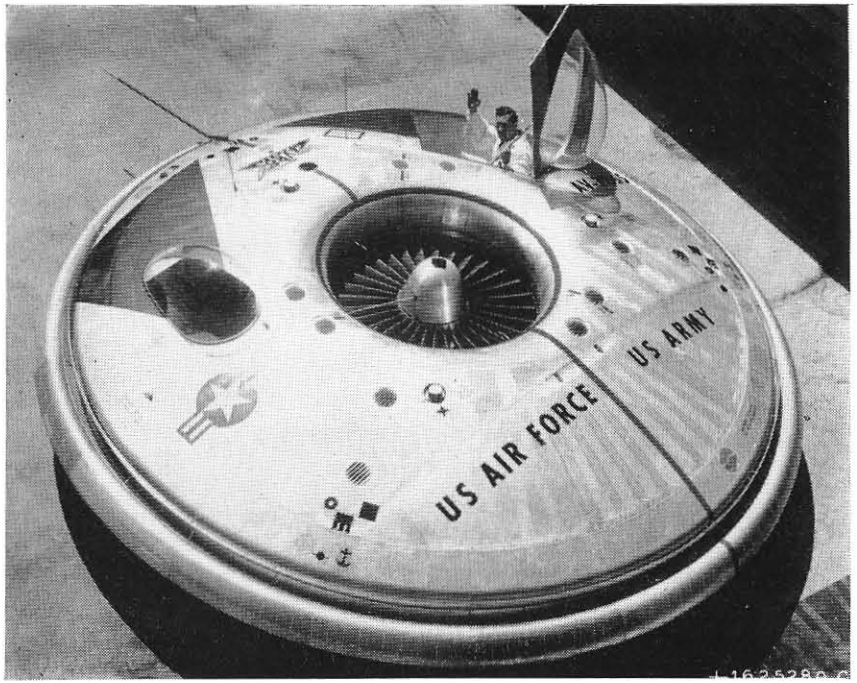
AVRO CANADA CF-105 ARROW

This was an all-metal, twin turbojet all-weather fighter which originated from a 1952 R.C.A.F. requirement to which Avro Canada Ltd. submitted alternative C-104 Mk. 1 single engined and CF-104 Mk. 2 twin engined delta wing designs. The CF-105 Arrow was a smaller, lighter version of the latter, with two 23,000 lb. s.t. Pratt and Whitney J75s specified for the two prototypes, and two 28,000 lb. s.t. Orenda Iroquois for production machines.

First prototype *25201*, first flown at Malton 25.3.58 by Jan Zurakowski, exceeded 1,000 m.p.h. on the level during its seventh flight. Pre-production batch of 37 ordered 6.58. Second prototype *25202* completed 9.58 was followed by *25203–25205*.

In February 1959, after some £108 million had been spent on development of the Arrow airframe and Iroquois engine, the whole programme was dropped in favour of Bomarc surface to air missiles.

Span 50 ft. 0 in., length 77 ft. 9½ in., all-up weight 60,000 lb., maximum speed 1,200 m.p.h.



(U.S. Air Force Photo.)

AVRO MODEL 1 AVROCAR

A disc shaped, two seat, VTOL research aircraft purchased outright by the U.S. Department of Defence in 1955 as the Weapons System 606A (WS606A) and allotted U.S. Army designation VZ-9V. Three Continental J-69 turbojets turned a large diameter central fan to create a peripheral air cushion for take-off, but the machine developed normal aerodynamic lift after transition to forward flight. After six years of experiment it first flew at Malton 5.12.59 and later went to California for further wind tunnel and flight testing at the Ames Laboratory, Moffett Field, where it was first flown 17.5.61 as *58–7055*.

Estimated maximum speed (at altitude) 300 m.p.h., estimated range 1,000 miles.

APPENDIX C

AVRO PROJECTS

Although the designation system introduced by A. V. Roe with the type number Avro 500 in 1912 had reached the Avro 780 by 1963, only about 30% of the possible designs were actually built. The remaining designations mainly represent unbuilt projects, but it must be remembered that in several instances they were passed over and not used at all, in others they were applied to sub-assemblies built for other aircraft constructors, and in a number of cases (where an earlier design study was abandoned), were used twice. This Appendix lists all projects not mentioned in the main text.

Avro 505 Type number not used.

Avro 506 Also known as Type J. Layout made in 1913 for a two seat, twin float seaplane similar to the Avro 508 and powered by a 160 h.p. or 200 h.p. Gnome pusher. A machine gun was mounted in the nose. Span 70 ft. 0 in. Length 44 ft. 0 in. Height 15 ft. 5 in. Wing area 980 sq. ft. All-up weight 3,800 lb. Endurance 4 hr.

Avro 507 Designation allocated to a set of mainplanes built for a Mr. Leigh in July 1913. He is believed to have been the purchaser of an experimental Avro 534 Baby in 1920. See page 145.

Avro 509 Type number first used for a set of tanks and strut sockets supplied to the Walsh brothers for the first Walsh flying boat, built at Orakei, Auckland, N.Z. in August 1913. Evidently these components were later considered unworthy of a special type number as the designation Avro 509 was reissued in November 1913 to a projected radio equipped twin float seaplane. This was a three seater, three bay biplane with two 120 h.p. Austro-Daimler engines outboard and a heavy calibre gun in the nose. Span (upper) 80 ft. 0 in. (lower) 56 ft. 0 in. Length 44 ft. 3 in. Wing area 931 sq. ft. Tare weight 2,800 lb. All-up weight 4,510 lb. Maximum speed 70 m.p.h.

Avro 512 A projected landplane with one 65 h.p. Austro-Daimler engine. Span 26 ft. 0 in.

Avro 513 A design study made in March 1914 for a two seat, twin float bomber seaplane powered by two 80 h.p. Gnome engines. Wings were designed to fold, and floats and flying surfaces were interchangeable with those of the Avro 510. Span (upper) 72 ft. 0 in. (lower) 47 ft. 0 in. Length 36 ft. 6 in.

Avro 515 Layout for a biplane with one 150 h.p. Sunbeam engine, September 1914.

Avro 516 A monoplane with one 80 h.p. Gnome considered in January 1915.

Avro 517 Layout for a biplane version of the Avro 516, February 1915.

Avro 518 A projected single seater with one 150 h.p. Sunbeam engine, May 1915.

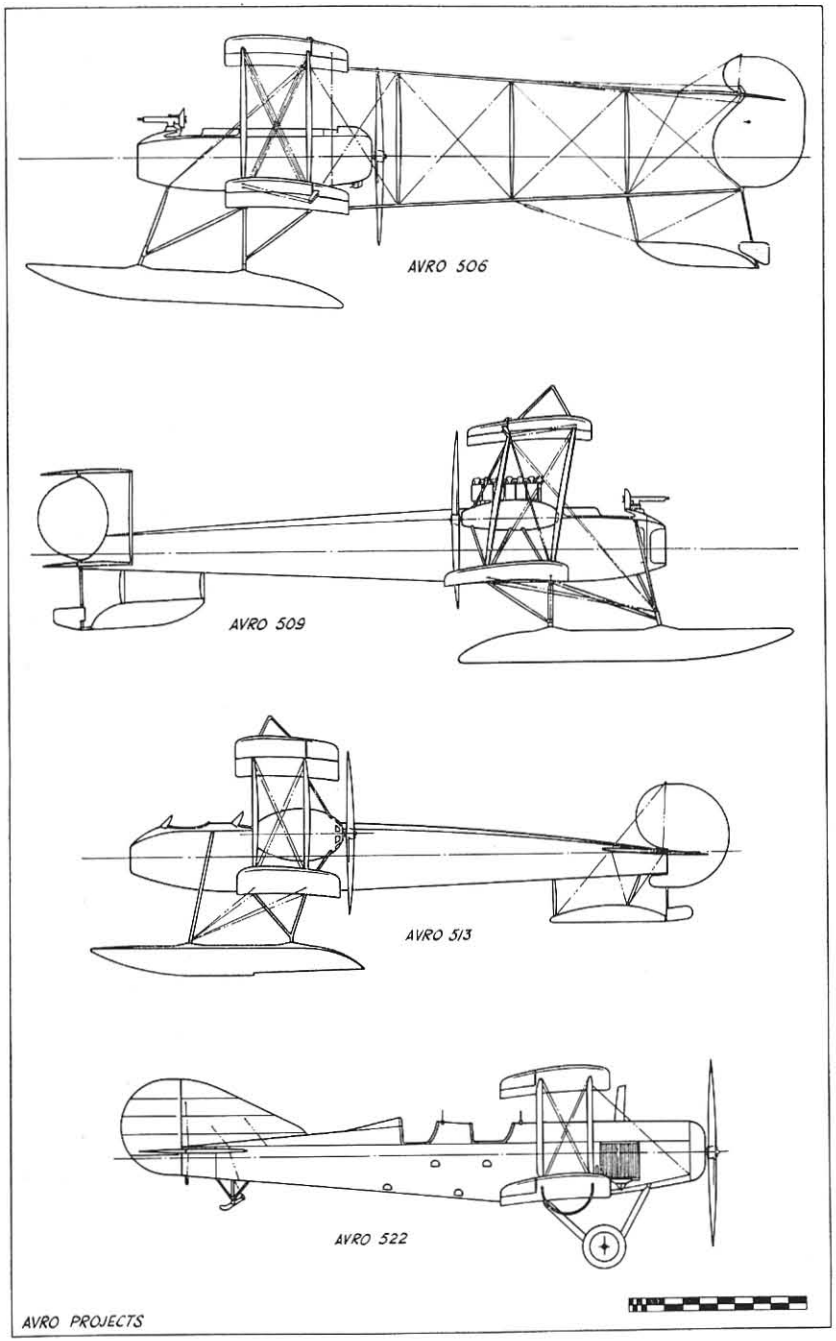
Avro 520 Designs for a single seat landplane with one 150 h.p. Sunbeam engine for the Royal Navy, May 1915.

Avro 522 Drawings made in September 1915 for a two seat land biplane with folding wings and unspecified 150 h.p. engine. A higher powered version with one 225 h.p. Sunbeam engine, suggested in August 1916, was known as the Avro 522A. Span 45 ft. 0 in. Length 33 ft. 8 in.

Avro 524 A projected scout with one 80 h.p. engine.

Avro 525 Layout for a single seat ground attack fighter to R.A.F. Type II, November 1915.

Avro 526 Similar to the Avro 525 but with monoplane tail unit.



Avro 532 This has been widely quoted as a postwar single seat racer, a mistaken belief based on the false assumption that the sporting version of the Avro 531A had been allotted the next Avro type number. This was not so, the civil machine in question being the Avro 538. Drawings dated April 14, 1918 show the true Avro 532 as a projected two seater (one 350 h.p. A.B.C. Dragonfly radial) to R.A.F. Types IIIA, IIIB and IVB, adaptable as short range reconnaissance fighter, artillery spotter or long distance photographic aircraft. Span 40 ft. 0 in. Length 27 ft. 10 in.

Avro 535 Design study made in April 1919 for an Avro contender for the *Daily Mail* £10,000 prize for the first Transatlantic flight. It would have been an unstaggered biplane with one 275 h.p. Rolls-Royce Falcon III and an enclosed cabin for the crew. Forestalled by Alcock and Brown's crossing in a Vickers Vimy, the Avro 535 was not built. Span 45 ft. 0 in. Length 36 ft. 3 in.

Avro 537 Designs made in March 1919 for a transport biplane for pilot and ten passengers, powered by two 300 h.p. high compression Siddeley Puma engines in outboard nacelles. Span 70 ft. 0 in. Length 46 ft. 0 in.

Avro 541 A projected twin float fleet reconnaissance seaplane to R.A.F. Type XXI, September 1919. It was envisaged as a folding wing sesquiplane powered by one 450 h.p. Napier Lion. Span 40 ft. 0 in. Length 30 ft. 0 in. Height 12 ft. 10 in.

Avro 542 Layout made in October 1919 for a passenger transport with one 450 h.p. Napier Lion engine.

Avro 550 Earmarked either for a projected three seat fleet reconnaissance triplane to Specification 37/22; or a 15 passenger European civil transport with three Rolls-Royce Condors to Specification 40/22.

Avro 564 Preliminary designs for a two seat fighter monoplane with thick section eliptical wing, powered by one 650 h.p. Rolls-Royce Condor III, July 1924.

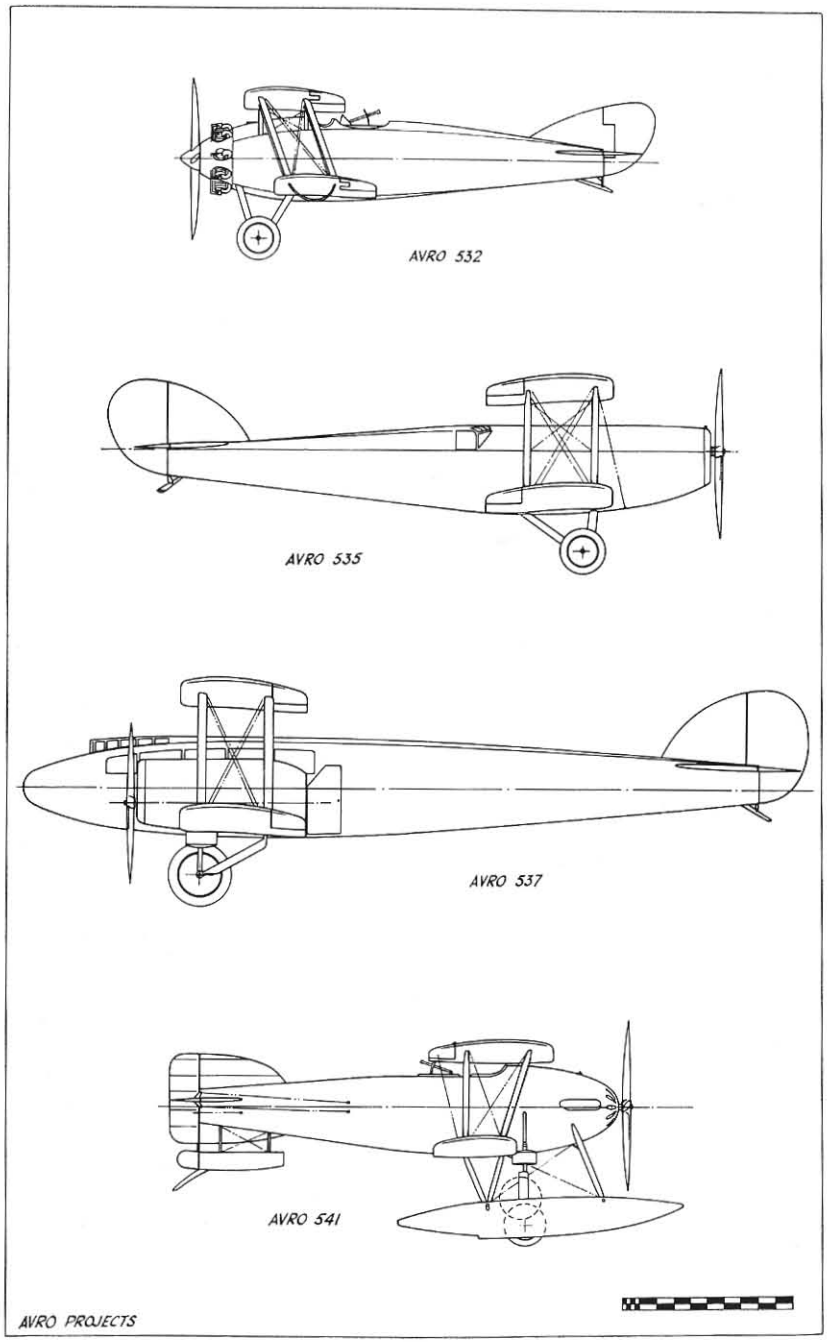
Avro 565 A version of the Avro 564 powered by one 450 h.p. Napier Lion, July 1924.

Avro 568 Projected all-metal single seat fighter, November 1925.

Avro 570 Layout for a single seat seaplane, November 1925. Span 32 ft. 0 in. Length 29 ft. 3 in.

Avro 573 Design study for a large commercial biplane with folding wings and three Bristol Jupiter engines to joint Imperial Airways and Air Ministry Specification 26/24. Intended for the Cairo–Baghdad desert air mail route, the aircraft resembled an enlarged three engined Andover with double freight doors on the port side. Choice fell on the de Havilland D.H.66 Hercules and the Avro 573 was not built. Span 100 ft. 0 in. Length 60 ft. 6 in. Height 18 ft. 8 in.

Avro 577 A projected general purpose landplane, January 1926.



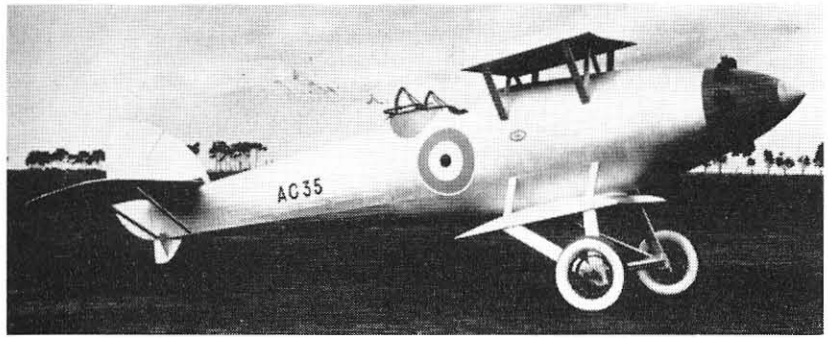
Avro 578 Seaplane version of the Avro 577. Span 48 ft. 0 in. Length 37 ft. 9 in.

Avro 579 Projected Avro 562 Avis with R.A.F. 15 wing section.

Avro 580 Layout for a heavy bomber powered by four Bristol Jupiter radial engines, February 1926.

Avro 590, 591 and 592 Variations on a single basic layout for high performance Army Co-operation two seat, two bay biplanes (one 450 h.p. Bristol Jupiter VI) to Australian Government Specifications A.C.35, 36 and 37, October 1927. H. E. Broadsmith took the Avro 590, 591 and 592 drawings to Australia and campaigned vigorously to get them adopted for local manufacture, even to the extent of building a full size, wood and canvas mock-up at Melbourne. No orders rewarded this enterprise because a British military commission at that time in Australia insisted that in time of war all Australia's needs could be supplied by Britain.

Avro 593 A two seat seaplane version of the Avro 590–592 series, powered by one Armstrong Siddeley Jaguar radial, October 1927.



The full scale mock-up of the projected Avro 590 Army Co-operation biplane built at Melbourne by H. E. Broadsmith in 1927.

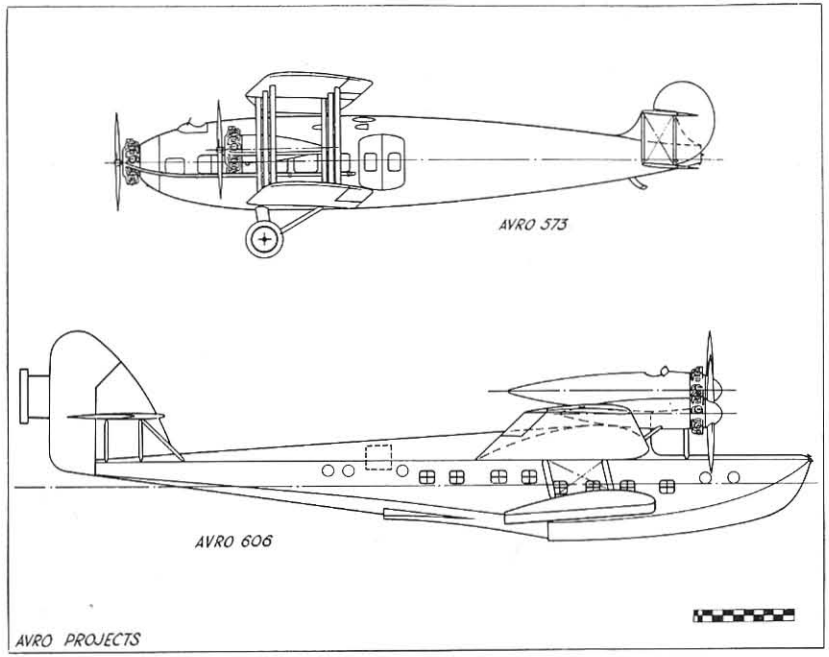
Avro 595 A projected two seat land or seaplane reconnaissance fighter to Specification O.22/26, February 1927.

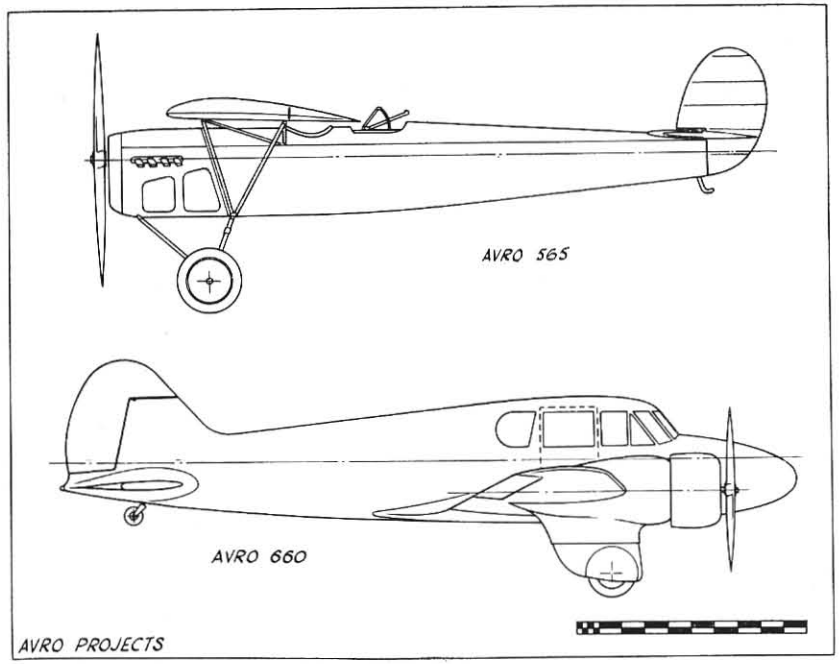
Avro 596 The three seat bomber version of the Avro 595.

Avro 598 and 599 Type numbers allocated to designs for a two seat trainer to Australian Government Specification. Although not built, they were given the names Warregull Mk. I and Mk. II respectively.

Avro 601 Projected two seat reconnaissance landplane powered by one 450 h.p. Napier Lion, April 1927.

Avro 603 Designs for three engined, 8 passenger monoplane for West Australian Airways Ltd. H. E. Broadsmith conducted negotiations in Australia in May 1927 but the design was eventually turned down in favour of Vickers Viastra II monoplanes delivered in 1931.





Avro 606 and 607 Schemes drawn up in October 1927 to Air Ministry Specification 4/27 for Imperial Airways flying boats for the Mediterranean section of the new India air route. Large three engined monoplanes were envisaged, the Avro 606 with square section and the Avro 607 with circular section hull. The production contract was awarded to the Short Calcutta and neither of the Avro designs was built. (Avro 606) Three 505 h.p. Bristol Jupiter VIII. Span 110 ft. 0 in., Length 80 ft. 0 in. All-up weight 21,050 lb. Maximum speed 120 m.p.h. (Avro 607) Span 96 ft. 4 in.

Avro 609 Preliminary designs for a three seat, general purpose military seaplane based on the Avro 608 Hawk and powered by one Bristol Jupiter radial, December 1927.

Avro 610 A projected high wing cabin monoplane, similar to the de Havilland D.H.75 Hawk Moth, to be powered by any engine of 200 h.p., e.g. the Armstrong Siddeley Lynx, Wright Whirlwind or Bristol Titan. Pilot and four passengers sat in a glazed cabin beneath a one-piece mainplane mounted directly on top of a welded steel tube fuselage. An alternative shoulder-mounted scheme with glazed cabin roof was also considered. The fin and rudder were typically Avro Avian. Span 43 ft. 6 in. Length 27 ft. 6 in. Wing area 266 sq. ft. Tare weight 1,800 lb. All-up weight 3,140 lb. Maximum speed 123 m.p.h. Cruise 110 m.p.h. Initial climb 700 ft./min. Ceiling 15,500 ft.

Avro 613 Layout made to Air Ministry Specification B.19/27 in May 1928 for a night bomber powered by two Armstrong Siddeley Jaguar IV radial engines. There were no detail designs and the machine was not built, contracts being placed instead for the Handley Page Heyford and Fairey Hendon prototypes.

Avro 614 and 615 Type numbers allotted in June 1928 to preliminary designs for a high wing commercial monoplane powered by three 180 h.p. Armstrong Siddeley Lynx IV radials. A single pilot occupied an open cockpit ahead of a one-piece, thick section, strut braced mainplane and the outboard engine nacelles were above each wheel. Avro 615 was the proposed twin float version, but when the Fokker licence was acquired, both projects were shelved in favour of the Avro 619 Five.

Avro 623 Layout for a survey or general purpose single or two seat, high wing monoplane with one Armstrong Siddeley Lynx or Cheetah radial.

Avro 632 A project considered in September 1932 for a Fleet torpedo bomber/reconnaissance aircraft with one Armstrong Siddeley Tiger radial to Air Ministry Specification S.9/30. Choice fell on the Hawker Osprey and the Avro 632 was not built. Span 46 ft. 0 in.

Avro 634 A projected two seat low wing monoplane, May 1932. Span 30 ft. 0 in. Length 24 ft. 9 in.

Avro 635 Layout for a low wing cabin monoplane with one Armstrong Siddeley Lynx IVC, July 1932. Span 39 ft. 0 in. Length 28 ft. 4 in.

Avro 644 A projected two seat reconnaissance bomber with one Armstrong Siddeley Jaguar radial, 1933. Span 36 ft. 0 in. Length 26 ft. 6 in.

Avro 645 A projected six seater powered by two 340 h.p. Armstrong Siddeley Double Mongoose (Serval) radials.

Avro 647 and 648 These were low wing projects with six seats and two 140 h.p. Armstrong Siddeley Genet Major IA radials, June 1933. Span 50 ft. 0 in. and 46 ft. 0 in. respectively.

Avro 649 Layout for a 17 seat seaplane with four 240 h.p. Armstrong Siddeley Lynx radials.

Avro 650 A projected eight seat monoplane with four 140 h.p. Armstrong Siddeley Genet Major radials, July 1933.

Avro 651 A project considered in August 1933 for a monoplane with one Armstrong Siddeley Jaguar VI radial in the nose and two 240 h.p. Armstrong Siddeley Lynx IVC outboard.

Avro 653 A projected long range seaplane with four Armstrong Siddeley Cheetah IIA radials, October 1933.

Avro 655 and 656 These were projects for low wing bombers powered by two Armstrong Siddeley Jaguar VIA radials.

Avro 657 Layout for a high performance military aircraft, December 1933.

Avro 658 Layout for a three seat, low wing monoplane with one 140 h.p. Armstrong Siddeley Genet Major IA radial.

Avro 659 and 660 Scaled down versions of the Avro 652 transport powered by two 140 h.p. Armstrong Siddeley Genet Major IA radials, and fitted with fixed trousered undercarriages. The Avro 659 was not proceeded with but a mock-up of the Avro 660 was built in January 1934 and construction of a prototype reached the stage where c/n 723 and registration *G-ACUN* were allotted. Maximum speed 165 m.p.h., cruise 140 m.p.h., range 420 miles.

Avro 666 A layout made in October 1934 for a Fleet Air Arm fighter/dive bomber to Specification 0.27/34 and powered by one Armstrong Siddeley Tiger radial. Span 39 ft. 0 in. Length 32 ft. 10½ in.

Avro 668 Following the abandonment of the Avro 665 Commodore-type Cierva C.33 autogiro, designs went ahead in February 1935 for the Avro 668 twin engined, rotary wing cabin aircraft having an entirely new fuselage of Avro design. Equipped with three bladed rotor, it would have been the C.37 in the Cierva series but was not built.

Avro 670 Preliminary designs drawn up in October 1935 for an Army Co-operation aircraft to Air Ministry Specification A.39/34.

Avro 672 A projected twin engined reconnaissance aircraft to Air Ministry Specification G.24/35 and M.15/35. Span 56 ft. 3 in.

Avro 673 Layout for a twin engined advanced gunnery trainer with 200 h.p. de Havilland Gipsy Six, October 1935.

Avro 675 A projected twin engined reconnaissance aircraft to Air Ministry Specifications G.24/35 and M.15/35, May 1936, powered by Armstrong Siddeley Terrier engines.

Avro 676 and 677 Layouts for low wing advanced trainers with Rolls-Royce Kestrel engines, made to Air Ministry Specification T.6/36 in May and June 1936 respectively. Construction did not take place due to the adoption of the Miles Master I.

Avro 678 A scheme for a twin airscrew fighter, powered by a single Rolls-Royce Merlin engine, August 1936.

Avro 680 Layout prepared in April 1939 for a 4 engined heavy bomber to Air Ministry Specification B.1/39. There were no detail drawings and the type was not built.

Avro 681 and 682 Type numbers allotted to heavy bomber projects.

Avro 693 Projected medium/long range turboprop transport for the Commonwealth routes. The design emerged finally as a large turbojet aircraft with four Rolls-Royce Avons and having a wing area of 2,700 sq. ft. but was cancelled in 1947.

Avro 697 Projected medium range Empire transport, June 1947.

Avro 700 Layout made in January 1945 for a 12 seat transport with two 475 h.p. Armstrong Siddeley Cheetah 26.

Avro 702 Preliminary designs made in January 1945 for a Canadian aircrew trainer to R.C.A.F. Specification 4/10.

Avro 703 Projected 36 seat turbojet powered transport.

Avro 704 Designs for a two seat trainer powered by two Rolls-Royce Derwent turbojets, November 1947.

Avro 705 Projected transport with tricycle undercarriage and four Rolls-Royce Nene turbojets.

Avro 714 Designs for a basic trainer powered by a single turbojet.

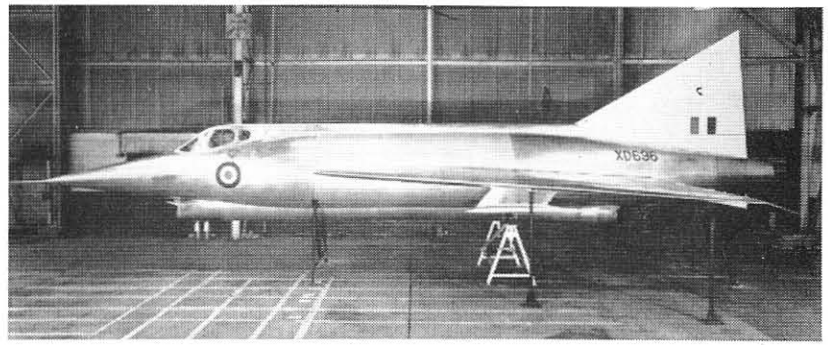
Avro 715 A projected 8–10 seat four engined passenger transport.

Avro 718 A four turbojet military transport.

Avro 720 Designs for a mixed power plant delta fighter commenced in 1954 to Ministry of Supply Specification 137. Interception with D.H. Firestreak missiles was to be made on the power of one Armstrong Siddeley Screamer rocket, the aircraft then returned to base on an Armstrong Siddeley Viper unit. Prototype *XD696*, nearly complete, scrapped in the 1956 economy drive. Span 27 ft. $3\frac{1}{2}$ in. Length 48 ft. 6 in.

Avro 721 Preliminary designs for a low level bomber, October 1952.

Avro 722 The Avro Atlantic long range, four turbojet, delta transport considered in December 1952. Based on the Vulcan it was to carry up to 113 tourist class passengers from London to New York in under 7 hours. Span 121 ft. 0 in. Length 145 ft. 0 in. A.U.W. 200,000 lb. Cruise 600 m.p.h.



The incomplete Avro 720 rocket interceptor prototype *XD696*, in the Avro works 1956. (*Avro Photo.*)

Avro 723 A projected 'DC-3 replacement' powered by four Alvis Leonides radials, May 1953.

Avro 724 Designs for a VTOL aircraft as alternative to the Avro Canada Avrocar, June 1953 (see page 446).

Avro 725 Projected advanced trainer based on the Avro 720 and powered by a single turbojet, October 1953.

Avro 726 A single engined turbojet delta night fighter, November 1953.

Avro 727 Ground attack fighter to NATO Specification, February 1954, Avro 720 delta wing and new fuselage housing one Bristol Orpheus turbojet and two 20 mm. cannon. Abandoned when contract was awarded to the Fiat G.91. Span 27 ft. $3\frac{1}{2}$ in. Length 35 ft. $9\frac{1}{2}$ in.

Avro 728 Mixed power plant naval interceptor developed from the Avro 720, March 1955.

Avro 729 Single turbojet all-weather fighter, January 1955.

Avro 730 Preliminary designs 1955 for an 8 turbojet supersonic bomber of stainless steel sandwich construction for which D.H. Gyron Junior powered flying scale models were envisaged.

Avro 731 Three-eights scale experimental and development aircraft for the Avro 730, with two turbojets, October 1955.

Avro 732 Supersonic bomber with four turbojets, July 1956.

Avro 733 Type number of Avro designed Shackleton-type mainplane for the A.W.650 Argosy transport (four Rolls-Royce Darts). Span 115 ft. 0 in.

Avro 734 No details released.

Avro 735 Design study for a supersonic passenger aircraft, November 1956.

Avro 736 A turboprop transport for two or four engines, November 1956.

Avro 737 A four engined STOL aircraft considered in January 1957.

Avro 738 Designs for a weapons system, 1957.

Avro 739 Low level supersonic aircraft, 1957.

Avro 740 Design study for a short haul, swept wing, 70 passenger transport to a British European Airways specification issued in 1956, with three turbojets grouped round a butterfly tail. To have been built jointly with Bristols as the Bristol 200 but was dropped when B.E.A. ordered the D.H.121 Trident.

Avro 741 A twin jet executive or feeder line transport, July 1957.

Avro 742 A three engined jet flap transport, July 1957.

Avro 743 A long range military freighter with four turboprops, July 1957.

Avro 744 Nuclear powered aircraft studies 1957.

Avro 745 NATO maritime patrol or reconnaissance aircraft with turboprop engines, August 1957.

Avro 746 Single turboprop jet flap research aircraft, August 1957.

Avro 747 Passenger or freight transport with two Rolls-Royce Dart turboprop engines, October 1957.

Avro 761 and 771 Parallel design studies discussed in 1962 for low wing, turbofan transports with high tail and 35 degrees of sweepback to succeed the Avro 748, with either two Bristol Siddeley B.E.75 (50 passengers, A.U.W. 60,000 lb.) or Rolls-Royce R.B.163 (65 passengers in long fuselage, A.U.W. 70,000 lb.) rear mounted engines. Both to cruise at 480 knots over 500 mile stage lengths. Schemes shelved in 1963.

APPENDIX D

INDIVIDUAL HISTORIES OF BRITISH CIVIL AVRO 504K AIRCRAFT

This section is arranged to show former R.A.F. serial and/or constructor's number, registration, date of issue of Certificate of Airworthiness, all owners, and disposal. Unless subsequently changed the home base is given only when an operator is first mentioned. Avro 504Ks granted temporary British civil markings for ferrying abroad, or whose careers were spent mainly overseas, are dealt with in full in the Avro 504K (Overseas) chapter.

Abbreviations: A.C.—Aircraft Co. Ltd.; A.S.—Aircraft Services Ltd.; A.T. & T.—Aircraft Transport and Travel Ltd.; Av. Co.—Aviation Co. Ltd.; Avro—A. V. Roe and Co. Ltd.; B.A.T.—Berkshire Aviation Tours Ltd.; E.W.—Engineering Works Ltd.; F.S.—Flying Services Ltd.; G. W.—Grahame-White Aviation Co. Ltd.; L. & P.—London and Provincial Aviation Co. Ltd.; N.A.L.—Northern Air Lines; N.A.T.—Northern Air Transport Ltd.; N.S.—North Sea Aerial Navigation Co. (later Aerial and General Transport Co. Ltd.); R.Ae.S.—Royal Aeronautical Society; s.o.r.—struck off register; S. of F.—School of Flying Ltd.; W.B.—William Beardmore and Co. Ltd.

E4222/G-EAAK, 9.5.19, Avro, Hounslow, s.o.r. 11.21; *E4154/AL*, 29.5.19, Avro, Southsea, 2.23 Vickers Ltd., Brooklands, 1925 to Avro 548; *E3289/AM*, 9.5.19, Avro, Hounslow, s.o.r. 9.20; *E4225/AN*, 5.5.19, Avro, Weston-super-Mare, s.o.r. 5.20; *D6205/AX*, 12.5.19, G.W., Hendon, s.o.r. 5.20; *C724/AY*, 7.5.19, G.W., 9.24 Lady U. Beecham, Hendon; 5.25 Liverpool Av. Co., 4.26 Southern Counties Av. Co. "Jake", Brooklands; 10.26 F. G. Miles, Shoreham; 4.27 L. J. Skytrips Ltd.; 7.30 L.R.G. Errington, Bekesbourne, crashed 1931

E3480/G-EABA, 27.5.19, G.W., s.o.r. 5.20; *E4137/BE*, 18.5.19, G.W., 9.23 E. F. Edwards, Whitley Bay, crashed 12.5.24; *C748/BF*, 11.7.19, G.W., s.o.r. 7.20; *C749/BG*, 30.5.19, G.W., s.o.r. 5.20; *B8758/BH*, 7.8.19, G.W., s.o.r. 8.20; *E4359/BJ*, 19.5.19, Avro No. 3*, Blackpool, s.o.r. 5.20; *D8287/BK*, 18.5.19, Avro, Southport, s.o.r. 5.20; *E4324/BL*, 19.5.19, Avro, Alexandra Park, s.o.r. 5.20; *E4360/BM*, 19.5.19, Avro No. 2, Southport, s.o.r. 5.20; *C723/BN*, 9.5.19, G.W., s.o.r. 5.20; *D6202/BO*, 27.5.19, G.W., to Canada 5.20 as *G-CAAE*; *F9802/BP*, 18.5.19, G.W., sold abroad 7.21; *D6201/BT*, 20.5.19, L. & P., Stag Lane, s.o.r. 8.19; *D6229/BV*, 18.5.19, Avro, crashed 12.19; *C747/BW*, 25.5.19, G.W., s.o.r. 1.23; *E4230/BX*, 20.5.19, G.W., 8.22 Manchester Av. Co., Alexandra Park, s.o.r. 8.23

E6765/G-EACA, 18.6.19, G. J. Lusted, Shoreham, 2.21 H. Sykes, Kingsbury, crashed 1.10.21; *E1671/CB*, nil, Avro, s.o.r. 9.20; *E4224/CD*, 16.5.19, Avro, crashed 12.19; *D9298/CL*, 10.6.19, J. D. V. Holmes, East Hanney, crashed near Northampton 5.8.19; *D9341/CS*, 20.5.19, Avro, s.o.r. 5.20; *E4233/CV*, 24.6.19, Vickers Ltd., Joyce Green, crashed 4.20; *E1663/CW*, 2.6.19, Avro, Southsea, in the sea 11.19

E4221/G-EADA, 19.5.19, Avro, 1923 to Avro 504N; *E1665/DD*, 25.5.19, Avro, s.o.r. 5.20; *E3502/DH*, 31.5.22, West of Scotland Av. Co., 5.22 Kingwill and Jones Flying Co., s.o.r. 2.30; *E3292/DI*, 25.5.19, Avro, Morcambe, s.o.r. 5.20; *E4336/DM*, 10.6.19, Avro, Southsea, to Belgium 8.21; *E3293/DN*, 5.6.19, Avro, to Belgium 7.21; *F8706/DO*, 16.6.19, Central A.C., Northolt, crashed 12.19; *E3481/DP*, 11.8.19, Central A.C. "White Wings", 10.21 Midland Av. Co., 3.23 Manchester Av. Co., 3.24 Northern Av. Co., Alexandra Park, crashed 3.5.24; *D7588/DQ*, 6.6.19, Central A.C., Irish Air Corps 6.22; *D6245/DR*, 10.7.19, Bournemouth Av. Co., crashed 8.20; *H2507/DS*, 24.6.19, Vickers Ltd., crashed 4.20; *D9329/DU*, 1.7.19, Central A.C., 9.20 J. M. Drysdale, Caversham, 8.23 D. M. Matthews, 9.23 J. E. A. Binnie, Renfrew, 7.24 N. S. McConnell, Renfrew, s.o.r. 7.25; *E4343/DW*, 24.6.19, Avro, wrecked at Rhyl 8.19; *D6230/DX*, 24.5.19, Avro, s.o.r. 5.20; *E3408/DY*, 7.8.19, Navarro Av. Co., 5.20 Astra E.W., Hendon, sold abroad 1.21

D9304/G-EAEA, 3.7.19, Navarro Av. Co., 5.20 Astra E.W., sold abroad 1.21; *B8774/EB* 3.7.19, Navarro Av. Co., 7.20 S. Summerfield, crashed

*Avro Transport Company fleet numbers are given where known.

3.10.21; *E3501/EC*, 1.9.19, Cambridge S. of F., Hardwicke, to Australia 8.19 as *G-AUDQ*; *D9018/EN*, 13.6.19, Avro No. 11, Southport, crashed 1.20; *E4362/EO*, 13.6.19, Avro No. 10, Morecambe, s.o.r. 6.20; *H2586/EV*, 24.6.19, Avro, s.o.r. 7.21; *H2560/EY*, 1.7.19, Vickers Ltd., crashed 4.20; *H2561/EZ*, 30.6.19, Vickers Ltd., crashed 4.20

E1660/G-EAFC, 10.7.19, Avro No. 16, wrecked by gale at Rhyl 8.19; *E4329/FD*, 25.6.19, Avro No. 12, Southport (flew as *D4329*), 3.20 J. Blake and Co., Liverpool, s.o.r. 3.21; *D7648/FE*, 10.7.19, Avro, crashed 8.9.21; *E3363/FP*, 1.7.19, Central A.C., to Australia 12.21 as *G-AUFP*; *E4180/FQ*, 7.8.19, T. J. Rogers, 9.21 Stallard Airways, Herne Bay, crashed at Hildenborough, Kent 11.21; *D9340/FS*, 10.7.19, Avro No. 15, Southport, s.o.r. 7.20; *H6543/FX*, nil, Golden Eagle Av. Co., Squires Gate, wrecked by gale 8.19, rebuilt as *G-EASG*

H5173/G-EAGB, 15.12.19, Aerial Photos Ltd., Edinburgh, 8.22 Midland Av. Co., crashed 22.10.23; *H5172/GC*, 12.8.19, L. & P., 12.19 Aerial Photos, 3.23 Manchester Av. Co., s.o.r. 3.24; *D5499/GD*, nil, damaged and reconstructed as *G-EALE*; *E4234/GI*, 14.8.19, Central A.C., crashed 7.20; *C746/GJ*, 2.8.19, Central A.C., crashed at Twickenham 12.19; *D9343/GO*, 2.8.19, Avro. crashed at Southport 8.19; *D6217/GT*, 2.8.19, Kingsbury Av. Co., 5.20 Astra E.W., 8.20 Oxfordshire Av. Co., crashed 3.21; *H6598/GV* and *H6599/GW*, 2.8.19, N.S., Leeds, crashed 9.20; *D8984/GZ*, 7.8.19, C. A. Crichton, Sunderland, s.o.r. 7.20.

E4340/G-EAHK, 12.8.19, Bournemouth Av. Co., 2.20 J. W. Gibson, 2.21 J. Barnes, s.o.r. 2.22; *E4118/HL*, 12.8.19, Cambridge S. of F., 10.20 Leatherhead Av. Co., Croydon, 3.23 Manchester Av. Co., crashed 7.7.23; *E1707/HM*, 2.8.19, T. D. Lewis, crashed 12.19; *H1959/HO*, 7.8.19, H. V. David, crashed at Aberystwyth 28.8.19; *E1611/HU*, 7.8.19 Aerial Photos, 5.22 W. L. Woodward, Castle Bromwich, crashed 10.2.22; *H2297/HV*, 7.8.19, Aerial Photos, s.o.r. 1.23; *E3364/HW*, 6.9.19, Handley Page Ltd., Cricklewood, crashed in Southwark Park, London 31.3.20; *E3366/HX*, 6.9.19, Handley Page Ltd., s.o.r. 8.21; *H7513/HY*, 26.8.19, West of Scotland Av. Co., 9.23 W. B., Renfrew, s.o.r. 1.29; *H2411/HZ*, 26.8.19, West of Scotland Av. Co., 8.21 F. J. V. Holmes, crashed 1.3.23

F8717/G-EAIA, 26.8.19, West of Scotland Av. Co., 8.20 Border Av. Co., 3.23 R. Atkinson, s.o.r. 3.24; *D9303/IB*, 12.8.19, J. D. V. Holmes, 6.20 Anderson and Pool Av. Co., Ipswich, s.o.r. 6.21; *E1675/IG*, nil, Aerial Photos, s.o.r. 10.19; *H2595/IH*, 8.8.19, Avro, Amsterdam, to Belgium 7.21; *H2596/II*, 7.8.19, Avro, Amsterdam, crashed 8.21; *H2597/IJ*, 7.8.19, Avro, Amsterdam, s.o.r. 8.20; *E3359/IO*, 22.9.19, A.T. & T., Hendon, s.o.r. 8.20; *E4143/IP*, nil, A.T. & T., s.o.r. 8.20; *E4144/IQ*, 28.8.19, A.T. & .,T scrapped 11.20; *E4164/IR*, 28.11.19, A.T. & T., 9.21 Surrey F.S., Croydon, crashed at Hayling Island 21.8.23; *E4170/IS*, nil, A.T. & T., sold abroad 4.20

H1956/G-EAJG, 14.7.19, Eastbourne Av. Co., 3.22 T. Baden Powell, crashed at Penshurst, Kent 20.8.22; *D7619/JK*, 29.8.19, Central A.C., 5.21 Vulcan Av. Co., crashed 5.22; *E1728/JP*, 14.8.19, Navarro-Wellesley Av. Co., 5.20 Astra E.W., sold abroad 1.21; *H2587/JQ*, 20.8.19, Avro, Amsterdam, 8.20 H. W. B. Hansford, Lyme Regis, crashed 10.20; *H2592/JU*, 20.8.19, Avro, Amsterdam, 5.22 Gnat Aero Co., Shoreham, 8.28 J. C. Don, s.o.r. 1.30; *H2594/JZ*, 27.8.19, Avro, Brighton, 11.22 W. G. Pudney, Canvey, Essex, 7.23 D. M. Matthews, crashed 11.8.23

H2588/G-EAKB, 26.8.19, Avro, s.o.r. 8.20; *H2593/KW*, 26.8.19, Avro, Hamble, s.o.r. 9.20; *H2600/KX*, 18.9.19, Avro, Brighton, 12.20 B.A.T., East Hanney, 6.29 N.A.L., Barton, 8.33 L. J. Rimmer, dismantled at Hooton 9.34; *H2599/KY*, 9.9.19, Avro, s.o.r. 9.20; *E3297/KZ*, 9.9.19, Avro, Brighton, s.o.r. 9.20

E1640/G-EALA, 7.10.19, Avro, 7.22 R. Taylor, crashed 21.8.22; *H1925/LB*, 10.6.19, Eastbourne Av. Co., 5.22 R. H. Leavey (Provincial F.S.), crashed 27.8.22; *D5499/LE*, 26.8.19, Aerial Photos, 8.22 Midland Av. Co., crashed 24.4.23

E3399/G-EAMI, 19.9.19, W. G. Pudney, written off 7.12.21; *J747/MN*, 26.9.19, Avro, s.o.r. 9.20; *J746/MO*, 26.9.19, Avro, Brighton, to Chile 9.21; *J745/MP*, 11.10.19, Avro, s.o.r. 10.20; *J748/MQ*, 7.10.19, Avro, s.o.r. 10.20; *E3724/MZ*, 26.9.19, Avro, 5.23 F. P. Raynham, 7.24 M. W. Piercey, 6.25 Earl of Kinnoull, crashed at Le Bourget 9.6.25

H2318/G-EANC, nil, Avro, s.o.r. 10.20; *J752/NF*, 3.10.19, Avro, s.o.r. 10.20; *H2514/NN*, 13.4.20, Sir P. Sassoon, Lympne, 3.20 H. Sykes, 9.20 Adastral Air Lines, crashed in France; *J756/NO*, 11.10.19, Avro, s.o.r. 10.20; *J755/NQ*, 11.10.19, Avro, 4.20 Border Av. Co., crashed at Carlisle 5.12.21; *E3358/NT*, 4.10.19, G.N. Ltd., Brooklands, s.o.r. 10.20

E3505/G-EAOE, nil, Lt.-Col. R. B. Bourdillon, Farnborough 1920, 5.22 B. Martin, Cleethorpes, crashed 13.6.22; *E3021/G-EAQU* and *E9443/QV*, 18.2.20, A. A. Mitchell, one crashed at Kelso, Roxburgh 24.5.20; *G-EARP*, 6.4.20, Pudney-Brettel-Owen Co., s.o.r. 4.21; *H6551/RZ*, 12.4.20, Bournemouth Av. Co., crashed 9.20

F9809/G-EASA, 12.4.20, Bournemouth Av. Co., 11.21 S. Summerfield, crashed 8.5.22; *F9810/SB*, 12.4.20, Bournemouth Av. Co., 5.25 C. P. B. Ogilvie, Hendon, crashed near Ripley, Yorks. 12.26; *D5858/SF*, 9.4.20, Cobham and Holmes Av. Co., 7.20 O. P. Jones, 3.22 F. J. V. Holmes, 6.29 N.A.L., Barton, 8.33 L. J. Rimmer, dismantled at Hooton 1937; *H6543/SG*, 22.4.22, Golden Eagle Av. Co., 7.21 J. S. Boumphrey, 7.22 Liverpool Av. Co., crashed 2.9.26; *F8902/G-EATB*, 22.6.20, A. R. Van den Bergh, written off 26.8.21; *E3045/TU*, 28.2.21, C. L. Pashley, Shoreham, 9.27 Gnat Aero Co., crashed on the Downs 1.29; *D6387/TV*, 26.6.20, International Av. Co., crashed 11.20; *E3022/TZ*, nil, J. M. Drysdale, re-registered *G-EAVC*

E3022/G-EAVC, nil, W. R. Bailey, scrapped 1.21; *E6757/VD*, nil, Handley Page Ltd., to Brussels 16.8.20; *E1644/VI*, 25.7.21, W. A. Hadden, s.o.r. 7.22; *E3672/G-EAWI*, 1.4.21, Surrey F.S., crashed near Croydon 9.21; *D2035/WJ*, 22.3.21, Surrey F.S., written off 2.22; *E3671/WK*, 22.6.21, Welsh Av. Co., Swansea, 4.22 Evan Williams, crashed in Swansea Bay 2.10.22; *E9341/WL* and *E9245/WM*, 20.4.21 and 29.3.21, Welsh Av. Co., 4.22 Evan Williams, s.o.r. 4.23; *D9051/G-EAXY*, 9.7.21 and *H6608/G-EAYB*, 22.7.21, Royal Aero Club, Croydon, wrecked 7.23; *H6609/YC*, 22.7.21, Royal Aero Club, Hendon, crashed 22.5.22; *H2295/G-EAZW*, 28.8.22, Manchester Av. Co., 3.24 Northern Av. Co., crashed at Brighouse, Lancs. 3.5.24; *E1860/ZX*, 24.7.22, Manchester Av. Co., 3.24 Northern Av. Co., crashed 2.8.24

F9783/G-EBAV, 20.4.22, Leatherhead Av. Co., crashed at Slough 20.8.22; *G-EBAY*, nil, H. Sykes, 7.22 A. Fraser, Kingsbury, s.o.r. 7.23; *E1843/G-EBBF*, 16.7.23, H. Sykes, 7.22 A. Fraser, sold abroad 3.24; *H221/G-EBCB*, 2.5.22, Kingwill and Jones Flying Co., written off 2.29; *E3379/CK*, 29.4.22, F. J. V. Holmes, 1.23 F. Neale, Epping, 2.25 B. Roberts, 5.26 H. Sykes, s.o.r. 1.28; *E9227/CL*, 20.4.22, W. R. Bailey, crashed 5.22; *H6547/CQ*, 22.5.22, Leatherhead Av. Co., 12.22 Manchester Av. Co., crashed 24.8.23; *F2284/G-EBDP*, 22.6.22. Surrey F.S., s.o.r. 12.30; *C691/G-EBEO*, nil, A. S. J. Chapman, written off 8.24

G-EBFV, 14.5.23, F. J. V. Holmes, 10.23 W.B., crashed 6.10.24; *E1850/FW*, 28.5.23, Surrey F.S., crashed at Bunford, Yeovil 17.9.27; *H6602/G-EBGH*, nil, Manchester Av. Co., crashed 5.6.23; *H2416/GI*, 12.6.23, Manchester Airways, s.o.r. 6.24; R/LE/10390/*G-EBGY*, 25.7.23, W.B., crashed 12.6.24; R/LE/10407/*G-EBGZ*, 25.7.23, W.B., 10.29 L J. Rimmer, dismantled at Hooton 1934; *G-EBHB*, nil, Manchester Airways, s.o.r. 8.24; R3/CL/10365/*HE*, 11.4.23, L. J. Rimmer, crashed 1.37; *E3794/HM*, 21.8.23, Surrey F.S., crashed 15.6.27

E1826/G-EBII, 12.11.23, Surrey F.S., s.o.r. 11.24; *G-EBIN*, 4.1.24, F. J. V. Holmes, crashed 25.7.24; R/LE/12663/*G-EBIS*, 9.2.24, W.B., 2.29 North British Av. Co., Hooton, crashed 22.4.35; *G-EBIZ*, 19.5.24, Cornwall Av. Co., St. Austell, s.o.r. 8.35; *G-EBJE*, 21.1.26, Southern Counties Av. Co., 1.26 J. R. Cobb, Brooklands, 8.26 F. G. Miles, 7.28 Southern Aircraft Ltd., Shoreham, s.o.r. 12.34, preserved by the R.Ae.S.; *E2969/G-EBKB*, 13.9.24, F. J. V. Holmes, 4.29 N.A.L., dismantled at Barton 12.32; *E3382/G-EBKR*, 24.3.25, F. J. V. Holmes, 8.27 C. L. Kent, 5.30 Wolverhampton A.C., s.o.r. 12.34; *G-EBKS*, 1.6.25, Southern Counties Av. Co., s.o.r. 2.28; *E3386/KX*, 9.5.25, F. J. V. Holmes, 7.29 N.A.L., 8.33 L. J. Rimmer, crashed at Crosby, Lancs. 21.7.34; R/LE/18615/*G-EBLA*, 1.7.25, N.S., Brough, 4.28 A. G. Cooper, in the sea at Weymouth 19.6.28

G-EBNH, 6.4.26, T. J. Carslake, Hooton, 5.27 South Wales Airways, crashed at Bridgend, Glam. 7.5.28; *F8864/NR*, 16.3.26, Cornwall Av. Co., s.o.r. 12.30; *F8865/G-EBOB*, 2.6.26, F. J. V. Holmes, s.o.r. 12.31; *G-EBQR*

14.4.27 Western Aviation Ltd., Cheltenham, 4.33 Aviation Tours Ltd., s.o.r. 4.37; *H2234/G-EBSE*, 29.7.27, Cornwall Av. Co., s.o.r. 1.33; *H257/SG*, 29.7.27, South Wales Airways, 5.28 Western Av. Ltd., s.o.r. 11.34; *H2365/SJ*, 16.4.28, A. H. Matthews, Maylands, 7.34 North British Av. Co., s.o.r. 5.35; *D6330/SL*, 27.8.27, F. J. V. Holmes, 5.30 N.A.T., Barton, crashed 9.5.32; *H9859/SM*, 10.8.27, F. J. V. Holmes, 5.28 J. Bunning Ltd., Pontypool, s.o.r. 12.30; *G-EBVL*, 9.1.28, L. E. R. Bellairs, Shoreham, 7.28 Southern Aircraft Ltd., 8.31 F. C. Fisher, Christchurch, scrapped 1939; *G-EBVW*, 18.5.28, F. J. V. Holmes, Shrewsbury, 7.29 N.A.L., dismantled at Hooton 12.31; *G-EBWF*, 21.3.28, L. J. Skytrips Ltd., 5.29 Alliston Av. Co., scrapped at Hornchurch, Essex 12.32; *G-EBWO*, 26.7.28, Dr. M. C. Wall, Woodley, 11.28 Phillips and Powis Ltd., Woodley, crashed 4.29

G-EBXA, 4.4.28, W.B., 7.29 North British Av. Co., s.o.r. 12.33; *G-EBXV*, 26.5.28, Western Av. Ltd., 4.33 Aviation Tours Ltd., s.o.r. 4.37; *G-EBYB*, 26.5.28, Gnat Aero Co., 3.30 Southern Aero Club, Shoreham, dismantled 2.33; *G-EBYE*, 30.6.28, Henderson S. of F., Brooklands, 8.28 Midland Aero Flights Ltd., 11.28 R. H. Jackson, 1.30 Brooklands S. of F., crashed at Brixton, London 2.2.31; *G-EBYW*, 3.9.28, Surrey F.S., 5.30 Aviation Tours Ltd., 5.34 Kinmel Bay F.S., Rhyl, s.o.r. 3.38; *G-EBZA*, 13.7.28, L. J. Skytrips Ltd., 8.30 L. R. G. Errington, s.o.r. 12.31; *H2262/ZB*, 2.10.26, Surrey F.S., 11.32 M.W. Allenby, Wilmington, s.o.r. 11.33

G-AAAF, 7.9.28, Cornwall Av. Co., 8.33 Surrey F.S., 6.35 H. V. K. Atkinson, Witney, 8.35 Flying Hire Ltd., Chilworth, burned at Gatwick 1939; *G-AACA*, 3.11.28, L. J. May, 2.29 Brooklands S. of F., 6.32 F. J. V. Holmes, s.o.r. 12.33; *F8811/CG*, 12.11.28, L. J. Anderson, s.o.r. 1.32; *G-AACW*, 27.7.29, Southern Aircraft Ltd., 11.30 Home Counties A.S., Shoreham, crashed at Gatwick 25.1.31; *G-AACX*, 20.11.28, Dominion Aircraft Ltd., Gatwick, crashed 4.29; *J8373/G-AADY*, 23.2.29, Henderson S. of F., 10.29 W. Cornell, 11.30 D. A. N. Watt, Ford, s.o.r. 12.31; *G-AAED*, 12.3.29, J. Sale and A. Barnett, Shoreham, crashed at Stag Lane 4.7.29; *G-AAEM*, 28.3.29, Brooklands S. of F., 7.29 Popular Flights Ltd., s.o.r. 12.31; *G-AAES*, 29.3.29, T. J. Carslake, burned at Hooton 1935; *G-AAEZ*, 27.3.29, Aeroplane Services Ltd., Castle Bromwich, 5.30 H. C. Howard, 8.31 N.A.L., 8.33 W. Mackay, s.o.r. 12.34

G-AAFE, 31.5.29, Inland F.S., Maylands, s.o.r. 12.30; *J8375/FJ*, 3.4.29, Henderson S. of F., 5.30 H. C. Howard, 11.30 Mrs. E. M. Watt, Ford, s.o.r. 12.31; *J8379/FT*, 26.3.29, A. B. Forsyth, 5.29 Inland F.S., s.o.r. 3.31; *G-AAGB*, 17.4.29, Surrey F.S., crashed 12.34; *G-AAGG*, 6.5.29, Phillips and Powis Ltd., 3.31 Rollason Av. Co., Croydon, s.o.r. 12.35; SP/1312(*sic*)/*G-AARV*, 7.11.30, S. Payne Jnr., crashed 2.1.31; *F2540/G-AASS*, 16.5.30, L. G. Anderson, Hanworth, 11.30 South Wales Airways, crashed 9.31; *F9819/ST*, 11.1.30, E. Brown, s.o.r. 12.32; *G-AASX*, 7.5.30, Alliston Av. Ltd., 7.30 R. M. Stobie, Brough, s.o.r. 12.32; *G-AATY*, 17.3.30, Wolverhampton A.C., scrapped at Driffield 1937

K.A.S.1/*G-AAUJ*, 28.3.30, Kent A.S., Kingsdown, crashed at Harrogate 5.10.32; K.A.S.2/*UK*, 28.3.30, Kent A.S., crashed on Epsom Downs 3.5.31; K.A.S.3/*UL*, 21.5.30, Kent A.S., crashed at Dovercourt, Essex 2.8.31; *F9720/G-AAVW*, 18.9.30, L. G. Anderson, 1.31 L. D. Trappitt, s.o.r. 12.35; *G-AAWB*, nil, Kent A.S., not converted; K.A.S.5/*WC*, 21.5.30, Kent A.S., 9.30 P. H. Meadway, s.o.r. 12.32; K.A.S.4/*WD*, 16.6.30, Kent A.S., dismantled 10.36; *H9833/G-AAYH*, 6.6.30, N.A.T., to Eire 3.32 as *EI-AAM*; *H9861/YI*, 29.5.30, Cornwall Av. Co., s.o.r. 12.31; *G-AAYM* 9.6.30, Surrey F.S., 4.33 Aviation Tours Ltd., 8.33 L. J. Rimmer, s.o.r. 12.34

G-ABAA, 11.9.30, G. & H. Aviations Ltd., Stag Lane, 3.33 Luff's Aviation Tours Ltd., 5.36 Williams and Co., Squires Gate, dismantled at Brooklands 1939; *G-ABAB*, 4.7.30, G. & H. Av. Ltd., 6.31 R. O. Roch, last flight 16.10.32; *J8353/AU*, 19.6.30, H. Sinclair, Chelmsford, s.o.r. 12.32; *J8348/AV*, 9.7.30, N.A.T., crashed at Holyhead, 9.30; *J8347/AW*, 21.6.30, N.A.T., s.o.r. 12.33; *G-ABAY*, 7.8.30, Surrey F.S., wrecked at Croydon 13.1.35; *H202/G-ABBF*, 2.7.31, Rollason Av. Co., 11.30 Mrs. E. M. Watt, Ford, 7.31 R. E. Pancoast-Bliss, Croydon, 10.31 Southend Flying Club, dismantled at Bekesbourne 7.32

G-ABGI, 12.6.31, Mrs. V. Brailey, 8.33 L. J. Rimmer, s.o.r. 1.36; *G-ABGJ*, nil, Mrs. V. Brailey, s.o.r. 12.34; *J8342/G-ABHI*, 7.3.31, N.A.T., 4.32 Cornwall Av. Co., s.o.r. 1.34; *J8343/HJ*, 7.3.31 and *J8351/HK*, 24.3.31, N.A.T., 8.33 L. J. Rimmer, crashed at Hooton 1933; *J8371/HP*, 14.3.31, N.A.T., to Eire 3.32 as *EI-AAN*; K.A.S.6/*G-ABJF*, 30.3.31, P. Turner, 3.32 Thanet Av. Ltd., s.o.r. 5.34

J8333/G-ABLL, 3.6.31, N.A.T., 8.33 L. J. Rimmer, crashed at Lowton Moor 8.34; *H3086/LV*, 16.5.31, R. H. Thomas, Wenvoe, S. Wales, scrapped 1936; *H3087/LW*, 16.5.31, R. H. Thomas, 8.33 South Wales Airways, s.o.r, 1.34; *E438/G-ABML*, nil, Calder Valley Aero Club, Burnley, not converted. K.A.S.7/*G-ABOL*, nil, Kent A.S., crashed 12.32; *G-ABSL*, 5.5.32, C. B. Field, Kingswood Knoll, Surrey, 8.32 Modern Airways Ltd., 4.33 L. J. Rimmer, s.o.r. 8.36; *H1986/SM*, 15.6.32, C. B. Field, 10.32 E. L. Gandar Dower, Shoreham, s.o.r. 12.37; *H2965/SN*, 7.7.32, C. B. Field, 7.32 L. & P., Herne Bay, 8.33 L. J. Rimmer, 12.34 P/O F. B. Chapman, Gosport, s.o.r. 4.38

G-ABTX, nil, J. Mackay, not converted; *J8365/G-ABUK*, 7.4.32, N.A.T., crashed at Hedon, Hull 3.9.32; *E9353/G-ABWK*, 27.6.32, Essex Flying Club, Abridge, 8.33 Kinmel Bay A.S., sold abroad 12.35; *G-ABYB*, 7.9.32, Essex A.C., Orsett, 10.32 H. M. Talbot-Lehmann, Chelmsford, s.o.r. 6.33; *G-ABZC*, 5.4.33, Devonshire Aviation Tours Ltd., crashed at Chard, Som. 30.4.33; *G-ACAU*, 26.4.33, C. B. Field, crashed at Epping 22.5.33; *G-ACAV*, 27.5.33, C. B. Field, s.o.r. 3.37

Index

With the exception of certain projects for which reference should be made to Appendix C, the index lists Avro aircraft both in numerical order of type numbers, and alphabetically by type name, suffixed variants normally being grouped with the basic type. Other aircraft intimately connected with the story of Avro aeroplanes are also listed.

Aiba
 Tsubami IV *139*
Armstrong Whitworth
 Argosy *427*, *457*
 Scimitar *308*
 Whitley *320*
Austin
 Kestrel *159*
Avro
 500 Type E *32*, *38*, *45*, *46*, *49*, *52*, *56*
 501 *52*
 503 Type H *52*, *66*
 504 *42*, *56*, *66*, *68*, *71*, *75*
 504A *58*, *61*, *75*, *80*, *127*
 504B *61*, *73*, *83*
 504C *61*
 504D *61*
 504E *62*, *75*
 504F *62*
 504G *62*, *75*, *90*
 504H *62*
 504J *64*, *65*, *80*, *127*, *132*, *150*, *197*
 504K *64*, *81*, *90*, *92*, *98*, *99*, *105*, *116*, *134*, *136*, *138*, *141*, *149*, *151*, *158*, *162–168*, *174*, *179–185*, *189–193*, *197*, *231*, *232*, *235*, *258*, *368*, *459*
 504K Mk. II *193*
 504L *107*, *108*, *121*, *124*, *131*, *132*, *134*, *138*, *149*, *150*, *158*, *174*
 504M *138*, *150*
 504N *87*, *88*, *115*, *120*, *121*, *164*, *174*, *179*, *193*, *195*, *200*, *202*, *208*, *231*, *257*, *283*, *287*
 504O *185–190*
 504P *195*
 504Q *195*
 504R Gosport *197*
 504S *198*
 508 *66*, *71*, *448*
 510 *68*, *73*
 511 *71*
 514 *72*, *220*
 519 *73*, *75*, *90*
 521 *75*, *82*
 523 Pike *77*, *90*, *92*, *102*
 527 *90*
 528 *90*
 529 *78*, *92*, *102*
 530 *95*
 531 Spider *98*, *450*
 533 Manchester *102*
 534 Baby *140*, *155*, *183*
 534A Water Baby *142*
 536 *107*, *138*, *149*, *158*
 538 *99*, *100*
 539 *154*
 540 *83*, *84*
 543 Baby *142*, *147*
 544 Baby *144*
 545 *162*, *166*, *174*
 546 *150*, *151*, *195*
 547 *142*, *158*
 548 *118*, *162*, *174*, *179*, *183*
 549 Aldershot *169*, *203*, *217*
 551 *174*
 552 *174*, *179*, *208*, *233*, *234*
 553 *162*
 554 Antarctic Baby *144*, *147*
 555 Bison *202*, *227*, *228*
 556 *207*, *208*
 557 Ava *207*, *208*
 558 *210*, *214*, *215*, *235*
 559 *214*
 560 *210*, *212*, *214*, *220*
 561 Andover *217*, *218*, *429*
 562 Avis *220*
 563 Andover *217*, *218*, *429*, *450*
 566 Avenger I *224*
 567 Avenger II *225*
 569 *225*
 571 Buffalo I *227*
 572 Buffalo II *228*, *229*
 574 Cierva C.6C *231*, *257*
 575 Cierva C.6D *231*
 576 Cierva C.9 *235*
 581 Avian prototype *222*, *235*, *243*
 582 *186*
 583 *225*
 584 Avocet *240*
 585 *198*, *200*
 586 Cierva C.8V *175*, *177*, *231*, *258*
 587 Cierva C.8R *231*
 588 *237*
 589 *237*
 594 Avian *145*, *198*, *225*, *237*, *238*, *243*, *261*, *262*
 597 *229*

Avro—continued.
600 *245*
602 *225*
604 Antelope *254*, *299*
605 *247*, *252*
608 Hawk *299*, *301*, *454*
611 Cierva C.8L Mk. I *233*, *257*
612 Cierva C.17 *250*, *261*, *434*
616 Avian IVM *263*
617 Cierva C.8L Mk. II *257*
618 Ten *263*, *273*
619 Five *245*, *276*, *277*, *280*, *282*, *454*
620 Cierva C.19 *433*, *434*, *437*
621 Tutor *283*, *294*, *299*, *302*, *308*, *316*
622 *299*, *301*
624 Six *277*, *278*, *280*, *282*
625 Avian Monoplane *268–272*
626 *287*, *292*, *317*, *318*
627 Mailplane *299*
628 *277*
629 *277*
630 *300*
631 Cadet *302*, *309*, *311*
633 Cadet Fighter *302*
636 *308*
637 *294–298*
638 Club Cadet *311*
639 Cabin Cadet *312–316*
640 Cadet Three Seater *312–315*
641 Commodore *316*
642 *278–282*
643 Mk. II Cadet *302*
646 Sea Tutor *285*, *288–291*
652 *319*, *455*
652A Anson *319*, *364*, *441*
Nineteen *364*
654 *300*, *301*
661 *433*, *436*
662 *287*
663 Cadet Trainer *304*
664 *321*
665 Cierva C.33 *317*, *455*
667 *309*, *310*
669 *287*
671 Cierva C.30A/Rota *306*, *433*, *437*
674 Hawker Audax *8*, *433*, *439*
679 Manchester *334*, *339*
683 Lancaster *336*, *339*, *350*, *357*, *358*, *373*, *385*, *393*, *396*, *401*, *441*
684 *342*
685 York *352*, *357*, *441*
686 *342*
687 Type XX *373*
688 Tudor 1 *350*, *373*, *418*
689 Tudor 2 *380*, *418*
690 Type XXII *373*
691 Lancastrian *350*, *352*, *385*, *396*
692 Type XXIII *373*
694 Lincoln *342*, *352*, *373*, *381*, *393*, *403*, *441*
695 Lincolnian *397*
696 Shackleton *390*, *395*, *403*, *457*
698 Vulcan *408*, *422*, *456*, *457*
699 *380*
701 Athena *414*, *422*
706 Ashton *382*, *418*
707 *408*, *409*, *422*
711 Trader *381*, *384*
712 *395*
717 *401*, *405*
719 *405*, *458*
748 *426*
748MF Andover *428*
757 *427*, *428*
758 *428*
778 *428*
780 *429*
Aldershot *169*, *203*, *217*
Andover (Avro 561) *217*, *218*, *429*, *450*
Andover (Avro 748MF) *428*
Anson *319*, *364*, *441*
Antarctic Baby *144*, *147*
Antelope *254*, *299*
Ashton *382*, *418*
AT-20 *324*, *329*, *332*
Athena *414*, *422*
Atlantic *536*
Ava *207*, *208*
Avenger *224*, *225*
Avian *145*, *198*, *222*, *225*, *235–238*, *243*, *261–263*, *268*, *283*, *454*
Avis *220*
Avocet *240*
Baby *140*, *142*, *144*, *147*, *155*, *183*
Bison *202*, *227*, *228*
Buffalo *227–229*
Cadet *302*, *309–316*
Commodore *316*
Curtiss-type *33*
Duigan biplane *35*, *38*
Eighteen *278*
Farman-type *33*, *39*
Five *245*, *276*, *277*, *280*, *282*, *454*
Gosport *197*
Hawk *299*, *301*, *454*
Hydrogiro *250*
L.B.I. *189*
L.B.IV *286*
Lancaster *336*, *339*, *350*, *357*, *358*, *373*, *385*, *393*, *396*, *401*, *441*
Lancastrian *350*, *352*, *385*, *396*
Lincoln *342*, *352*, *373*, *381*, *393*, *403*, *441*
Lincolnian *397*
Mailplane *299*
Manchester (Avro 533) *102*
Manchester (Avro 679) *334*, *339*, *350*
Nineteen *364*

Pike *77*, *90*, *92*, *102*
Popular *140*
Prefect *294–297*
Rota *306*, *437*
Sea Tutor *285*, *288*, *290*, *291*
Shackleton *390*, *395*, *403*, *457*
Six *277*, *278*, *280*, *282*
Sk 3 *131*
Sk 3A *190*
Spider *98*, *450*
Sports Avian *266*, *267*, *270*
Ten *263*, *273*
Tourist *162*
Trader *381*, *384*
Trainer *283*, *290*
Triton *284*
Tutor *283*, *294*, *299*, *302*, *308*, *316*
Tudor 1 *350*, *355*, *373*
Tudor 2 *380*, *395*
Tudor 8 *376*, *418*, *444*
Type D *25*, *26*, *35*, *47*, *140*
Type E *32*, *38*, *45*, *46*, *49*, *52*, *56*
Type F *31*, *46*, *49*
Type G *49*
Type H *52*, *66*
Type J *448*
Vulcan *408*, *422*, *456*, *457*
Warregull *452*
Water Baby *142*
York *352*, *357*, *441*

Avro Canada
CF-100 Canuck *441*, *442*, *444*
C-102 Jetliner *441*, *444*
CF-103 *444*
CF-104 *441*, *445*
CF-105 Arrow *441*, *445*
VZ-9V Avrocar *446*, *457*

British Aircraft Corporation
B.A.C. One-Eleven *411*
T.S.R.2 *411*
Beardmore
W.B.X *159*
Blackburn
Beverley *401*
Botha *323*
Buccaneer *411*
Monoplane *57*
Ripon *228*
Boeing
707 *419*
Fortress *403*
Bristol
Blenheim *8*, *433*
Brabazon *352*, *373*, *396*, *401*
Britannia *401*
Fighter *95*
Seely Puma *159*
Type 89A *111*
Type 200 *458*
Burga
Monoplane *45*
Canadair
C-4 *355*
Cierva
C.1 *231*, *232*
C.2 *231*
C.3 *231*
C.4 *231*
C.5 *231*
C.6A *231*, *232*, *234*
C.6B *232*, *234*
C.6C *231*, *257*
C.6D *231*
C.8L *233*, *257*
C.8R *231*
C.8V *175*, *177*, *231*, *258*
C.8W *258*
C.9 *235*
C.12 *261*, *262*
C.17 *250*, *261*, *434*
C.18 *258*
C.19 *433*, *434*, *437*
C.30A *306*, *433*, *437*
C.33 *318*, *455*
C.37 *455*
Consolidated
Liberator *403*
PT-1 *185*
Curtiss
Seagull *118*

de Havilland
D.H.10 *217*
D.H.27 Derby *169*
D.H.53 Humming Bird *214*, *215*
D.H.60 Moth *105*
D.H.66 Hercules *450*
D.H.82A Tiger Moth *270*
D.H.89M *320*
D.H.100 Vampire *389*
D.H.106 Comet *373*, *389*, *401*
D.H.121 Trident *411*, *458*
Deperdussin
Monoplane *231*
Douglas
Dakota/DC-3 *426*, *427*, *457*

English Electric
Canberra *8*, *433*

Fairey
Fox *254*
Hendon *454*
IIIF *205*
Farman
Pusher *28*, *39*
Fiat
G.91 *457*
Fokker
F.VIIA/3m *273*
F.VIIB/3m *273*

Gloster
Gorcock *224*

Gloster—continued.
Javelin *396*
Meteor *422*

Handley Page
O/7 *129*
Dart Herald *429*
Halifax *336*
Harrow *228*
Heyford *454*
Hyderabad *171*
H.P.56 *334*
H.P.117 *352*
Hawker
Audax *8*, *433*, *439*
Danecock *286*
Hart *254*
Hornbill *224*
Osprey *454*
P.1052 *422*
Tempest *414*
Tornado *433*

Junkers
Ju 86 *323*

Lakes
Water Bird *33*, *36*, *135*
Water Hen *34*
Sea Bird *36*, *37*
Lioré et Olivier
Le O. C.301 *437*
Lockheed
Hudson *323*

Mayfly
Biplane *33*
Miles
Master *456*

North American
Harvard *415*

Parnall
Monoplane *433*
Pixie *214*
Percival
Prentice *414*

Roe
I biplane *9*, *12*
I triplane *12*
II triplane *15*, *17*, *20*, *21*
III triplane *19*, *20*
IV triplane *24*, *26*, *28*
Royal Aircraft Factory
S.E.5A *88*, *95*, *174*, *184*

Saab
J 29 *356*
Short
Calcutta *454*
Sunderland *324*
Sopwith
Schneider *154*
Snipe *99*
Wallaby *159*
Wright *50*
Southern
Martlet *146*
Supermarine
Sea Lion *154*
Sud
Caravelle *401*
Sud/B.A.C.
Concorde *411*

Vickers
Valiant *409*
Vanguard *401*, *427*
Vespa *309*
Viastra *452*
Vimy *450*
Viscount *427*
Vivid *225*
Voisin
Biplane *10*
Goupy *12*

Wackett
Trainer *307*
Waco
UIC *316*
Walsh
Flying Boat *448*
Westland
Limousine *159*
Walrus *204*

Yokosuka
K1Y1 *185*
K2Y1 *185*
K2Y2 *185*